

Remedial Design Report Design Set 1B

**Harbor Island Soil and Groundwater
Operable Unit Superfund Site
Seattle, Washington**

Prepared by:

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RETEC Project No.: 1-2900-850

Prepared for:

**Design Set 1B Participants
Harbor Island Soil and Groundwater Operable Unit
Seattle, Washington**

August 15, 1997





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August 15, 1997

Mr. Keith Rose
EPA Remedial Project Manager
Harbor Island Superfund Site
EPA Region 10, ECL-111
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Seattle, Washington 98101

**RE: RESPONSE TO COMMENTS ON THE 95 PERCENT REMEDIAL DESIGN
REPORT - DESIGN SET 1B, HARBOR ISLAND SOIL AND GROUNDWATER
OPERABLE UNIT**

Dear Keith:

This letter provides complete responses to EPA comments on the 95 Percent Remedial Design Report and supplies additional information that was not available at the time of completion of the 95 Percent Remedial Design. The intent of this letter is to streamline the review process for the attached Final Remedial Design Report so that remedial activities may commence as soon as possible.

Comments by Keith Rose

Comment: Section 3.2.5, Former Lone Star Northwest Property

The intent of the proposed asphalt overlay near the southeast corner of the property is to reduce infiltration of rainwater through cracks in the existing concrete in order to prevent migration of TPH contamination identified at sampling location PS-4. The thickness of the asphalt overlay should be sufficient to meet the required cap permeability of 10^{-5} cm/second. The area of the asphalt overlay should be in proportion to the areal extent of TPH contamination at location PS-4. Specify the thickness and area of the asphalt overlay, with supporting justification, in the final design. Include recent arsenic sampling results on Figure 3-6.

Response: Sample PS-4 was collected within 18 inches of the surface adjacent to the existing fence line. It contained 836 ppm TPH as measured by EPA Method 418.1. This concentration is substantially smaller than the 10,000 ppm TPH removal criteria established for the S&GOU. No known sources of TPH are located in the vicinity of the sample collected. A visual inspection of the area indicated that the only exposed soil is located in nearby planter boxers. The entire area is capped with cement concrete. This existing concrete surface is sloped to drain surface water away from sample location PS-4 to an existing catch basin located to the southwest. A 20 foot square area was selected such that the minimal surface



infiltration that may be possible through minor cracks in the pavement would have to migrate laterally 20 feet under the slab to encounter the area around sample PS-4. Therefore, this size of asphalt overlay is sufficient to prevent any surface water infiltration through cracks in the existing concrete pavement from contacting the TPH-impacted area. The thickness of the asphalt overlay will be determined during mix testing; the thickness used will be the minimum thickness that satisfies the permeability criteria with a minimum thickness considered of 1 inch. Arsenic sampling results will be included in Figure 3-6.

Comment: **Table 5-1, Performance Standards Harbor Island S&GW OU**
Under "Testing Method" for asphalt debris, it should read, "Analytical Results < DW Criteria".

Response: Upon review of the table, it appears that the "Testing Method or Specification" column was correct in stating "Analytical Results > DW Criteria", however the "Level of Performance" column should have read "Subtitle C waste" rather than "Subtitle D waste".

Comment: **6.1.1, Notifications**
Rewrite the first paragraph of this section to say that property owners must notify EPA when they will be performing construction which will penetrate an existing cap in an area where there is contaminated soil beneath the cap. If this condition applies, property owners must get prior EPA approval on plans for handling, storage, and disposal of contaminated soil, which must be in compliance with applicable environmental regulations. Eliminate the rest of this paragraph which discusses a notification process to be established by EPA.

Response: Paragraph rewritten as follows: "Property owners must notify EPA prior to performing any site improvements that will impact the integrity of the cap in areas where there is previously identified contaminated soil. Property owners must obtain EPA approval of plans for handling, storage, and disposal of contaminated soil. These plans must be in compliance with applicable environmental regulations."

Comment: **6.3, Documentation and Reporting**
Instead of sending EPA a copy of the field logs upon completion of each inspection, a letter from the Harbor Island Steering Committee Project Coordinator, verifying that annual inspections have been completed, will be adequate.

Response: Paragraph rewritten as follows: "The Harbor Island S&GOU Steering Committee will provide an annual letter to EPA summarizing activities for the year."

Comments by Bob Stamnes

Comment 1. Documents should ensure runoff from contaminated areas and construction areas does not reach receiving waters during construction or after construction.

Response: Text was added throughout the document indicating that any runoff from impacted soil will be contained or otherwise prevented from entering storm drains.

Comment 2. This review does not address the work by David Evans on the Fisher Mills property as it is very incomplete.

Response: Work by David Evans on the Fisher Mills property is in the Final Remedial Design.

Comment 3. Section 2.1.2 stipulated that "If pavement integrity is not adequate,---". However, the criteria for determining adequacy is not included.

Response: As discussed in our meeting on July 16, this paragraph has been revised as follows: "As stated in the RDWP, "Existing asphalt and concrete surfaces, in areas where cleanup goals are exceeded have been inspected. If pavement integrity is not adequate, these areas will be repaired or replaced as necessary to prevent dermal contact with native soil." Existing pavement with loose or missing pieces or with potholes are defined as areas **with inadequate integrity** requiring repair or replacement during 1B remedial actions.

Comment 4. Section 2.2.5
This section requires dust suppression, but provides no criteria that must be met. The level of dust control is unclear. Criteria should be included to judge the effectiveness of dust control and to enable the oversight engineer to require additional controls when necessary.

Response: This section has been reworded to specifically reference Section 9.15 of PSAPCA Regulation I that indicates visual criteria for fugitive dust emissions.

Comment 5. Section 3.2.1, Subgrade Soil Disposition
This sample should be representative of the stockpile.

Response: Text has been added indicating that the sample will be representative.

Comment 6. Section 4.3.1, Design and Bid Plans
This section references two drawing of Grading and Paving Plan and Details that are not part of the package received.

Response: References have been removed. These were for additional drawings originally to be prepared by RETEC for Fisher Mills. The drawings will be replaced with those provided by David Evans and Associates.

Comment 7. Section 5

A provision should be included for the oversight engineer to have the permeability of the ACP tested if there is any reason to question the mix being used. Testing procedures should be incorporated also.

Response: This provision has been added to Section 5.

Comment 8. Table 5-1

- a. The word "site" used under Frequency of Testing is unclear. Does this refer to each owner's property, each stockpile, each area paved, etc.?
- b. The frequency stated is unclear. If there is more than 50 cubic yards, there should be more testing, not the same amount. The way it is stated, it appears only one test will be required per area, no matter how large that area is.
- c. Vegetation contains some soil, which may prove to drive the analysis. Why is Subtitle C not included under vegetation also? No testing required?
- d. Attach the documentation that demonstrates that the PCCP used here will meet the permeability criteria.

Response:

- a. The term "site" has been changed to "property" to more clearly identify the "Frequency of Testing".
- b. The "Frequency of Testing" statement has been clarified and now reads "Every 200 cubic yards and a minimum of once per property". This frequency has been decreased due to the increased volume of soil being generated at Fisher Mills.
- c. Vegetation will be disposed in the same manner as soil. No testing will be performed on vegetation.
- d. Documents demonstrating that PCCP meets the permeability criteria are attached to this letter and will be included in the Final Remedial Design.

Comment 9. Section 5.

Attach the referenced WSDOT specifications as an appendix.

Response: WSDOT specifications are attached to this letter and will be included in the Final Remedial Design.

Comment 10. Section 6.1.1

Improvements and other changes to the cap should be reported to EPA.

Response: Comment has been addressed based on the previous comment relating to Section 6.1.1.

Comment 11. Appendix B, General Requirements

a. Section 7 of General Requirements

The containment of contaminants from equipment should be addressed. Of particular concern is the tracking of contaminant from one area to another (from dirty areas to clean areas).

b. Section 7

The disposal of PPE is not addressed.

Response: a. The containment of contaminants from equipment is addressed under Decontamination.

b. A discussion of PPE disposal has been added.

Comment 12. Appendix B, Site Work Requirements

a. Section 3. The use of a 6 mil HDPE cover appears very light, especially if winds develop. This could result in the dispersion of contaminants. The use of a single, thicker sheet should be considered. Maintenance criteria should also be included.

b. Section 7 references a Table 1 which is not in the report.

c. Section 8 incorporates a reference for the permeability of mature concrete. However, there is no design specifications included for the mix tested.

d. Section 9 does not address when drawings must be marked with as-built details.

Response: **a.** The minimum thickness of the cover has been increased to 10 mil and maintenance criteria have been added. Temporary soil stockpiling at each site may also occur in roll-off storage containers that have either tarps or rigid plastic covers. Maintenance requirements consist of stockpile inspection on a minimum daily basis.

b. The reference to Table 1 has been removed.

c. The specification for PCCP to be used has been added.

d. Any changes in the construction plans shall be noted by the Contractor on the as-built drawings. As-built drawings shall be provided to the Oversight Engineer immediately following completion of the work.

Comment 13. Appendix C

a. Section 2.1

The sentence stating that "EPA will provide project Oversight." should not be included in this document.

b. Section 2.3 states "The contractor selected for capping activities will control the site." Does this refer to access?

c. Figure 2-1 should clearly indicate who will be doing Oversight Engineering.

- d. Section 2.3.2. The words "EPA will review, approve, and oversee capping activities." should be deleted. EPA is not required to approve or oversee.
- e. Table 3-1, Performance Standards
 - 1. Each layer of the fill material placed should be tested.
 - 2. Specific references should be included for the Nuclear Gauge and Washington Densometer tests.
 - 3. What is the basis for determining the adequacy of compaction in cut areas.
 - 4. Each container of Decon water should be sampled.
 - 5. Include copies of the various DOT specs.

Response:

- a. Statement has been removed
- b. As the various locations are active businesses, the contractor will not control access to each site. The contractor will be responsible for barricading, securing, and controlling access to their respective limited work areas.
- c. More specific references to the Oversight Engineer for each site have been added.
- d. Statement has been deleted.
- e.
 - 1. Each layer of fill material will be tested.
 - 2. The reference for field compaction testing is WSDOT 613. This reference has been added to the table.
 - 3. Since the capping areas are small and in low traffic areas, it was assumed that existing in situ compaction of subbase soil is sufficient. The comment section of the table indicates that the contractor will make a minimum of two passes over cut areas with a vibratory roller.
 - 4. Each container of decontamination water will be sampled and characterized.
 - 5. WSDOT specifications are included in the Final Remedial Design.

Comment 14. Drawing C-2.

- a. Sump marking does not concur with designation in Key of Drawing C-1.
- b. Drawing states "Drain sump, Out of Service". It is unclear if this still drains to receiving water. See comment 1 above.
- c. Drawing references a 6 foot tank. It appears paving will be located under a portion of this tank. Will it be moved? A complete description of the tank should be included.
- d. Reference is made to City of Seattle Best Management Practices. Attach the appropriate pages and include a complete reference.
- e. Note 3 references a liner, but does not ensure the liner is a continuous sheet bermed to prevent runoff.
- f. Note 3 references "limit". It appears this word should be eliminated.
- g. Note 4, references "profiling". Is this quantity estimates or contaminant level analysis?
- h. This drawing discusses responsibility for loading the trucks. It is unclear who is responsible for cleaning trucks prior to leaving the site.

- Response:**
- a. Sump marking has been changed to concur with Key.
 - b. Sump is completely out of service. A concrete curb surrounds the sump so that no surface water from the work area can enter or be conveyed.
 - c. A more complete description of the tank has been added. The tank will be relocated in order to allow paving to be performed.
 - d. Appropriate pages of the King County Sedimentation Control Standards and Washington State Department of Ecology Best Management Practices have been attached.
 - e. The stockpiles will be lined and covered to prevent erosion and the note has been changed to indicate continuous liner. No berms are anticipated as stockpiles will not be located in areas that interfere with surface water drainage patterns. The contractor will also be allowed to use covered storage containers as discussed previously in the response to Comment 12a.
 - f. Word has been removed.
 - g. "Profiling" refers to contaminant level analysis to determine appropriate off-site disposition. Text has been revised to make this more clear.
 - h. Contractor will be responsible for cleaning trucks prior to their leaving the site. Text has been revised to include this statement.

Comment 15. Drawing C-4

- a. Note 1. Who decides where blocks will be placed? This may be another source of contaminated material dispersal.
- b. Note 2 contains the word "limit", which may be advisable to remove.

- Response:**
- a. Oversight Engineer will decide where blocks are placed after conferring with the property owner. A statement has been added that any soil associated with the blocks will be removed and handled along with the other soil.
 - b. Comment noted, the word has been removed.

Comment 16. Drawing C-5

- a. The Enlarged Area drawing dimensions are "51 FT Approx". This is undefined. What is the criteria for determining how large an area will be addressed?
- b. The ACP overlay referenced in Note 9 has not been dimensioned.

- Response:**
- a. The extent of the Enlarged Area has been defined as the edge of the riprap slope located to the east, and the property line located to the west.
 - b. Dimensions have been added to the ACP overlay (20 feet by 20 feet).

Comment 17. Sheet 1 of 1 for Fisher Site

This drawing was not reviewed. There are however, many drains in this area. Runoff must be addressed.

- Response:** Fisher Mills drawings prepared by David Evans and Associates, Inc. are included in the Final Remedial Design.

Mr. Keith Rose
August 15, 1997
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in the Final Remedial Design.

Other Design or Text Changes For Your Review

1. Drawings, specifications, and the Bid Form provided by David Evans and Associates, Inc. have been included in the Final Design to allow EPA engineering design review.
2. Asphalt paving has been changed to concrete paving at Aspen Paints, the northern strip of the former Lone Star Northwest, and the planter box of the Union Pacific Railroad site.
3. The reference to Best Management Practices (BMPs) has been changed from the City of Seattle to the Washington State Department of Ecology BMPs and the King County Erosion and Sedimentation Control Standards.
4. Due to the increased volume of soil removal at Fisher Mills, subgrade preparation has been revised such that soil from around the exceedance soil sample (FM-07) will be removed and stockpiled separately.
5. A provision has been added to the Fisher Mills site to allow wasting of clean asphalt and concrete debris on site.

Please contact us with any comments or concerns. Upon your approval of this design document, we will begin measures to implement the remedial action.

Sincerely,
REMEDIATION TECHNOLOGIES, INC.



Bryan W. Stone, P.E.

cc: D. Heineck - Summit Law Group
M. Valentine - de maximus
A. Lovely - Lovely Consulting
E. Leavitt-Stetz - Port of Seattle

Remedial Design Report Design Set 1B

Harbor Island Soil and Groundwater Operable Unit Superfund Site Seattle, Washington

Prepared by:

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Seattle, Washington 98134**

RETEC Project No.: 1-2900-850

Prepared for:

**Design Set 1B Participants
Harbor Island Soil and Groundwater Operable Unit
Seattle, Washington**

Prepared by:


Grant Hainsworth, Task Manager

Technically Reviewed by:


Bryan Stone, Project Manager

August 15, 1997

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1 Introduction

1.1 Purpose

This Remedial Design report has been prepared by Remediation Technologies, Inc. (RETEC) on behalf of the Design Set 1B Settling Defendants designated in Consent Decree Civil No. C95-1495-Z (CD) for the Soil and Groundwater Operable Unit (S&G OU) of the Harbor Island Superfund Site (EPA, 1996a). This document is consistent with the requirements of the S&G OU CD, including the United States Environmental Protection Agency (EPA) Record of Decision (ROD), as amended (EPA, 1996b), and the *Remedial Design Work Plan* (RDWP) (RETEC, 1997a).

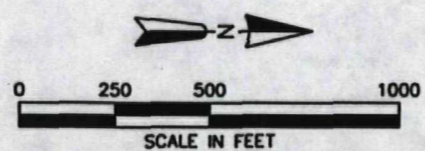
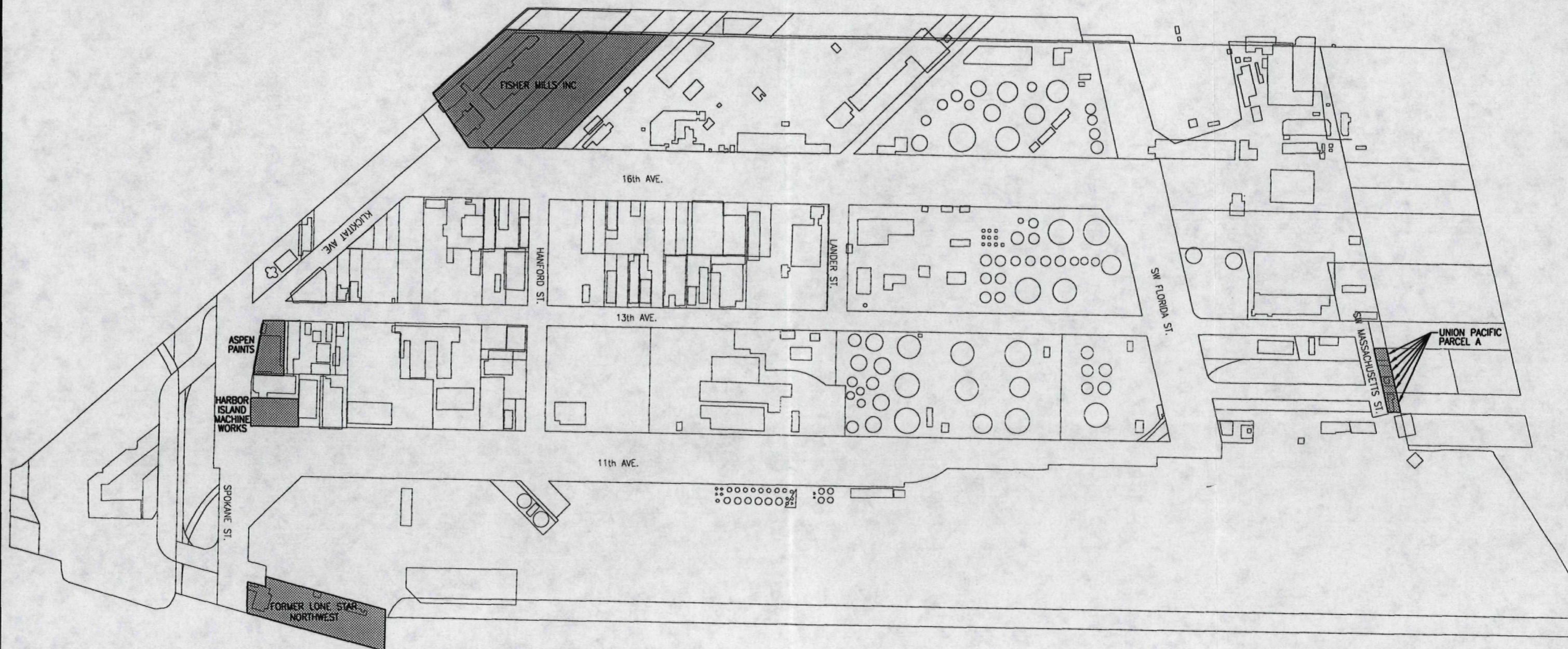
This document provides the basis for design of the remedial action (RA) and presents the design assumptions necessary for EPA to understand the approach. This document contains a description of each of the 1B properties and anticipated remedial activities associated with each property. This document has been prepared based on the Participant and EPA review of the 30% Technical Memorandum (RETEC, 1997b) and the 95 Percent Remedial Design Report (RETEC, 1997c).

1.2 Site Description

Design Set 1B Properties are those properties that lie outside of the anticipated Terminal 18 (T18) expansion footprint and only require capping as part of remedial actions. These properties include:

- Asahipen America, Inc. (Aspen Paints)
- Union Pacific Railroad Parcel A (Parcels B and D1 have been deleted from this design set as discussed in the February 1997 monthly progress report dated March 7, 1997)
- Harbor Island Machine Works
- Fisher Mills, Inc.
- Former Lone Star Northwest

Figure 1-1 is a site location map of the Harbor Island S&G OU with each of the 1B properties highlighted.



LEGEND	
	DESIGN SET 1B PROPERTIES

REFERENCE DWG	DESCRIPTION	NO	DRWN	DATE	REVISION	CHD	DATE	APPVD	DATE
6									
5									
4									
3									
2									
1									
0	E.F.	6/11/97	DRAFT						

**DESIGN SET 1B
HARBOR ISLAND S&GOU SUPERFUND SITE
1-2900-530**

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CURRENT DATE: 6/11/97 CAD FILE: 2900S015

**SITE LOCATION MAP
DESIGN SET 1B**

RETEC
REMEDIATION
TECHNOLOGIES INC.
DRAWING NO. 1-2900-530
FIGURE 1-1 10

1.3 Overview of Remedial Activities

To the extent practicable, those sites with surface soil that exceeds inorganic or organic cleanup criteria, as identified in the ROD, will be capped. The primary intent of capping is to prevent dermal contact with native soil, and to a lesser extent, to reduce infiltration. The cap will be composed of at least three-inches of asphalt concrete pavement (ACP) with a maximum permeability of 10^{-5} centimeters per second (cm/s) as stated in the ROD (EPA, 1996b). At some properties, reinforced Portland cement concrete pavement (PCCP) may be used for load-bearing surfaces based on property-specific commercial considerations or in areas where adequate compaction of ACP may be difficult to achieve. This type of cap will also be required to meet the permeability requirements stated above for the ACP cap.

Existing asphalt and concrete surfaces, in areas where cleanup goals are exceeded, have been inspected. Where pavement integrity is not adequate, these areas will be repaired or replaced as necessary to prevent dermal contact with existing native soil.

Several of the Design Set 1B properties include railroad tracks or landscape planter areas. Based on prior discussions with EPA, capping in active rail bed areas may be substituted with an equally protective dermal contact barrier comprised of 6 to 12 inches of railroad ballast. Active rail bed areas are defined as the area between rails, and between sets of tracks. Capping is not required in landscaped planter boxes.

1.4 Report Organization

Section 1 Introduction.

Section 2 Design Criteria. This section examines the capping design criteria, including a summary of chemical-specific criteria associated with the primary constituents which determine the need to perform the remedial action. It also briefly discusses those federal, state and local regulations that must be substantially complied with during the remedial actions.

Section 3 Scope of Work. This section presents the conceptual design for construction activities to be conducted on each 1B property. This section also provides a schedule and remedial action cost estimate for the activities to be performed for the Design Set 1B remedial action.

- Section 4 Design Activities.** This section defines the roles and responsibilities of the design team, and a description of the design documents, plans, and specifications to be prepared for this design set. Possible approaches to contract phasing and bidding are also discussed.
- Section 5 Quality Control.** This section outlines the remedial action quality control structure for the project. It also includes general requirements and performance standards.
- Section 6 Cap Inspection and Maintenance.** This section outlines the cap inspection and maintenance program to be followed by each of the IB participants upon completion of capping activities on their property. Procedures for repair of the cap are also documented.
- Section 7 References.**

2 **Design Criteria**

The design process involves translating remedial action objectives into design components and activities. The translation process starts with the documentation of specific criteria used to design each component, and evaluation of design performance during implementation. This section constitutes the basis of design for the 1B properties which includes:

- Statement of Work Objectives
- Specific Regulatory Requirements

2.1 Statement of Work Objectives

Objectives defined in the Statement of Work (SOW) (EPA, 1996c) for capping exposed soil exceeding cleanup goals include:

- Capping exposed contaminated soil exceeding inorganic or organic cleanup goals as identified in the ROD.
- Inspecting, repairing or replacing as necessary, existing asphalt and concrete surfaces in areas where cleanup goals are exceeded.

2.1.1 Design Criteria for Capping

Design criteria associated with soil capping were presented in the RDWP including cleanup goals and cap performance criteria specified in the ROD.

Chemical-Specific Capping Criteria (Cleanup Goals)

The primary constituents of concern for 1B property areas that require soil capping are TPH, TPAH, HPAH, arsenic, and lead. Remedial Investigation (RI) (Weston, 1993) analytical results for samples taken from the 1B properties were previously summarized by the EPA Project Manager in a sampling summary (EPA, 1994) (Table 2-1). Results provided in the EPA Sampling Summary (EPA, 1994) are for samples that have constituent concentrations above capping criteria. RETEC has used this summary to evaluate the extent of capping required for each 1B property. Specific capping criteria for the 1B properties stated in the EPA Sampling Summary (EPA, 1994) are also presented in Table 2-1.

Table 2-1 Soil Sample Constituents and Concentrations Above Capping Criteria as Listed in the EPA Sampling Summary*

Sample ID	Constituent Concentrations				
	HPAH (mg/kg)	TPAH (mg/kg)	TPH (mg/kg)	Lead (mg/kg)	Arsenic (mg/kg)
Capping Criteria	22.6	22.6	600	1,000	200
<i>Aspen Paints</i> HA-AP-03	30.20	36.27			
SS-IP-01			802.20	1,940.00	
SS-AP-02			752.30		
SS-AP-03			1,038.00		
SS-AP-04			2,373.20		
<i>Union Pacific Parcel A</i> SS-PT-54	33.38	45.73			207.00
<i>Harbor Island Machine Works</i> SS-MW-02-D1			2,771.50		
SS-MW-02-D2			1,868.60		
<i>Fisher Mills, Inc.</i> SS-FM-07	73.64	109.66	2,091.30		
<i>Lone Star Northwest</i> SS-PS-01-D1					231.00
SS-PS-01-D2					235.00
SS-PS-04			835.60		

NOTES:

* U.S. Environmental Protection Agency, 1994.

HA - hand auger sample

SS - surface sample

New Pavement Performance Criteria

The two requirements of any new pavement placed for the capping remedy are:

- Thickness: 3 inches minimum
- Permeability: 1×10^{-5} cm/sec maximum

2.1.2 Existing Pavement Evaluation Criteria

As stated in the RDWP, "Existing asphalt and concrete surfaces, in areas where cleanup goals are exceeded have been inspected. If pavement integrity is not adequate, these areas will be repaired or replaced as necessary to prevent dermal contact with native soil." Existing pavement with loose or missing pieces, with substantial settlement, or with potholes are defined as areas with inadequate integrity requiring repair or replacement during 1B remedial actions.

2.2 Regulatory Requirements

The potential applicable or relevant and appropriate requirements (ARARs) identified for Design Set 1B capping activities are described in detail in the following sections. Application for permits normally required for this site work will not be necessary given the Superfund site status, although the substantive requirements of such permits will be followed.

2.2.1 Washington State Dangerous Waste Regulations

Dangerous wastes may be encountered during this remedial action where arsenic and lead exceed toxicity characteristic criteria in soil. Dangerous waste regulations will be followed for handling, labeling, transportation and disposition of soil generated during site clearing and grading that may exceed these toxicity characteristic criteria.

2.2.2 Health and Safety

Washington Administrative Code (WAC) 296-155 specifies Safety Standards for Construction. This code specifies health and safety standards for responding to releases or substantial threats of releases of hazardous substances at hazardous waste sites. OSHA specifies health and safety requirements for hazardous waste sites (29 CFR 1910.120). Details regarding the use of 40-hour trained contractor personnel and requirements for the contractor's health and safety plan are provided in Section 5.

2.2.3 Stormwater Management

Best Management Practices (BMPs) for managing stormwater during remedial activities are provided in the Storm Water Management Manual for the Puget Sound Basin (Interagency Agreement between the City of Seattle and Port of Seattle regarding Storm Water, Grading and Drainage Control Code, Seattle Municipal Code Title 22.800). Additional stormwater management requirements are provided in the King County Erosion and Sedimentation Control Standards.

2.2.4 Shoreline Development

Remedial Actions and construction activities within control zones of shoreline areas must adhere to the Shoreline Development Permit Regulations (WAC 173-14). Proposed grading volumes at Union Pacific Railroad Parcel A and the former Lone Star Northwest property are likely small enough that they will not trigger the substantive requirements of this regulation. Grading work at Fisher Mills, Inc. will likely have to comply with the substantive requirements of this regulation.

2.2.5 Fugitive Dust Emissions

The Puget Sound Air Pollution Control Agency (PSAPCA) provides air emissions criteria for the Puget Sound area. Section 9.15 of Regulation I provides criteria pertaining to any fugitive dust emissions. The contractor will provide measures to suppress any fugitive dust generated during site grading that exceed Regulation I criteria.

2.2.6 Noise Control

The Washington Noise Control Act (RCW 70.107) and the Seattle Municipal Code (SMC, Title 25.800) provide maximum permissible decibel levels for all site activities, construction equipment, and portable powered equipment in temporary locations. All 1B sites are located in an industrial area and all work will most likely be conducted during daylight hours, thus no excessive noise will be generated that may be regulated under SMC.

3 Scope of Work

This section presents the scope of work for proposed RA capping activities at each Design Set 1B property. It also includes a proposed RD/RA schedule.

3.1 Remedial Design/Remedial Action Schedule

The RD/RA schedule (Figure 3-1) outlines the design phases and initial RA activities for the Design Set 1B Participants. The final design is scheduled for submission to EPA on August 21. The remedial action site work is currently scheduled to commence September 26.

3.2 Scope of Work

This section presents the scope of work for capping to be completed at each of the 1B properties. Proposed design scopes for each of the properties are based on:

- Remedial Investigation (RI) analytical results summarized by EPA for samples taken in the 1B properties (Table 2-1). Sample results noted in the EPA Sampling Summary (EPA, 1994) are those above capping criteria. RETEC has used this summary to evaluate the extent of capping required for each 1B property.
- The design approach taken by RETEC herein is to meet the relevant requirements as stated in the RDWP yet provide an economical design to meet the needs of each of the Design Set 1B Participants, and to satisfy the schedule and submittal requirements of EPA.

The proposed remedial design scope for each of the 1B properties is summarized in the following sections.

3.2.1 Aspen Paints Property

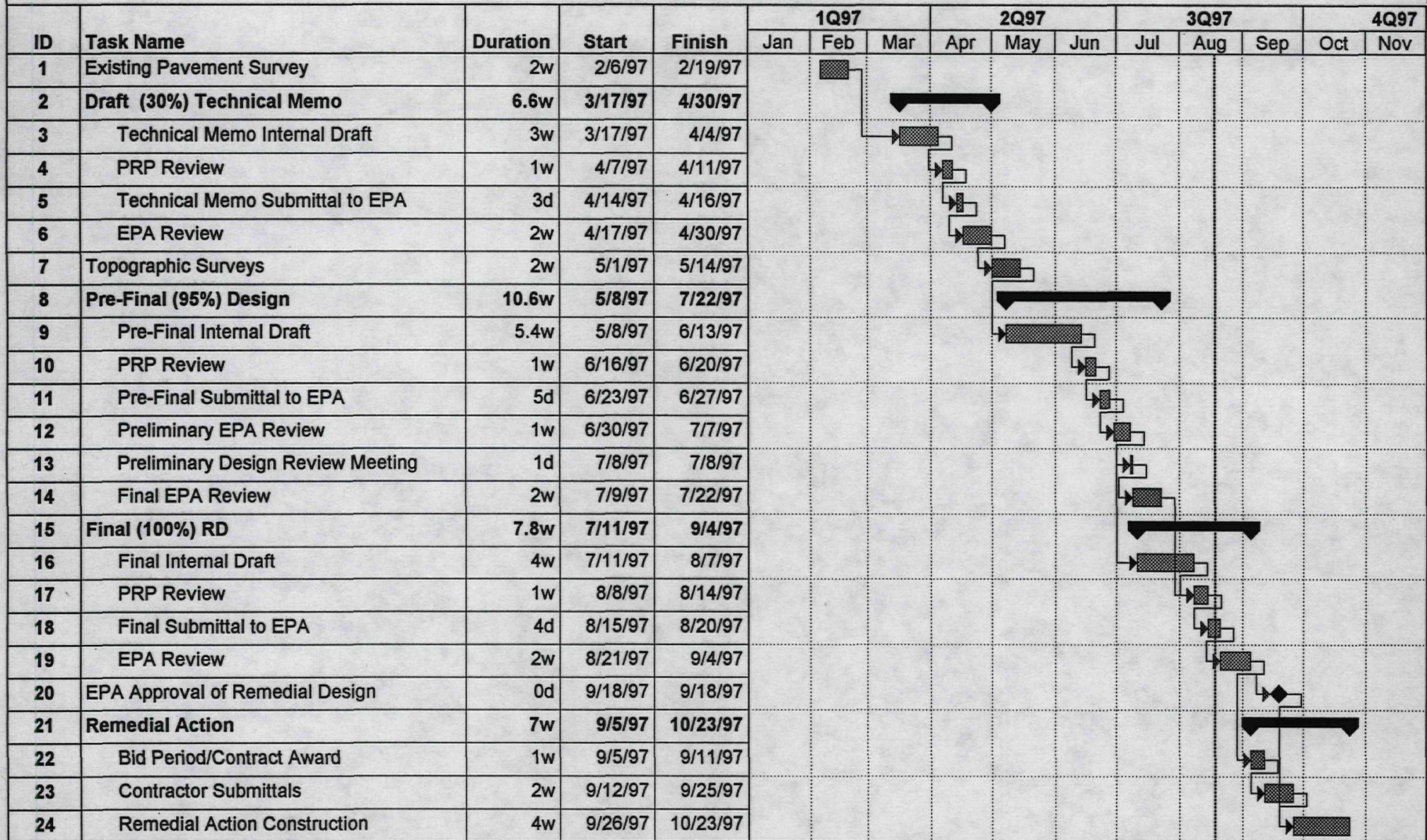
The proposed remedial action for this property is to cap the small strip of soil along the north edge of the property boundary. This strip of soil is approximately 250 feet long, ranging in width from 15 to 19 inches.

Design Rationale

Four samples were collected from this property at locations shown in Figure 3-2. All four samples were recorded in the EPA Sampling Summary (EPA, 1994) due to exceedances for total petroleum hydrocarbons (TPH), lead, and polynuclear aromatic hydrocarbons (PAHs).

FIGURE 3-1
DESIGN SET 1B SCHEDULE
HARBOR ISLAND S&G OU

4/25/97



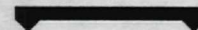
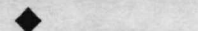
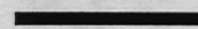
Design schedule is based upon anticipated remedial action schedules that may change due to unforeseen delays related to weather, property acquisition, disruption to commercial activities, or other circumstances.

Task

Progress

Milestone

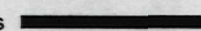
Summary



Rolled Up Task

Rolled Up Milestone

Rolled Up Progress



Sample, AP-1, was taken from a small narrow strip of exposed soil running the length of the north property boundary. Because this strip has not been landscaped and is located within the Aspen Paints property boundary, capping will be accomplished along the entire strip as shown in Figure 3-2. The area on both sides of the strip of exposed soil is composed of suitable PCCP.

Sample, AP-2, was taken from the southwest corner of the property. Based on discussions with Harold Perantie, the Port of Seattle is negotiating with Aspen Paints to purchase this corner. The Port plans on widening the road during the T-18 Expansion Project and will, therefore, cap the affected area as necessary at a later date.

Sample, AP-3, was taken from a landscaped area in front of the property. Based on prior discussions with EPA, no capping actions are required in landscaped planter areas.

Sample, AP-4, was taken in the alley between Aspen Paints and the building to the east. This area contains suitable existing PCCP. Therefore, no capping is proposed for this area.

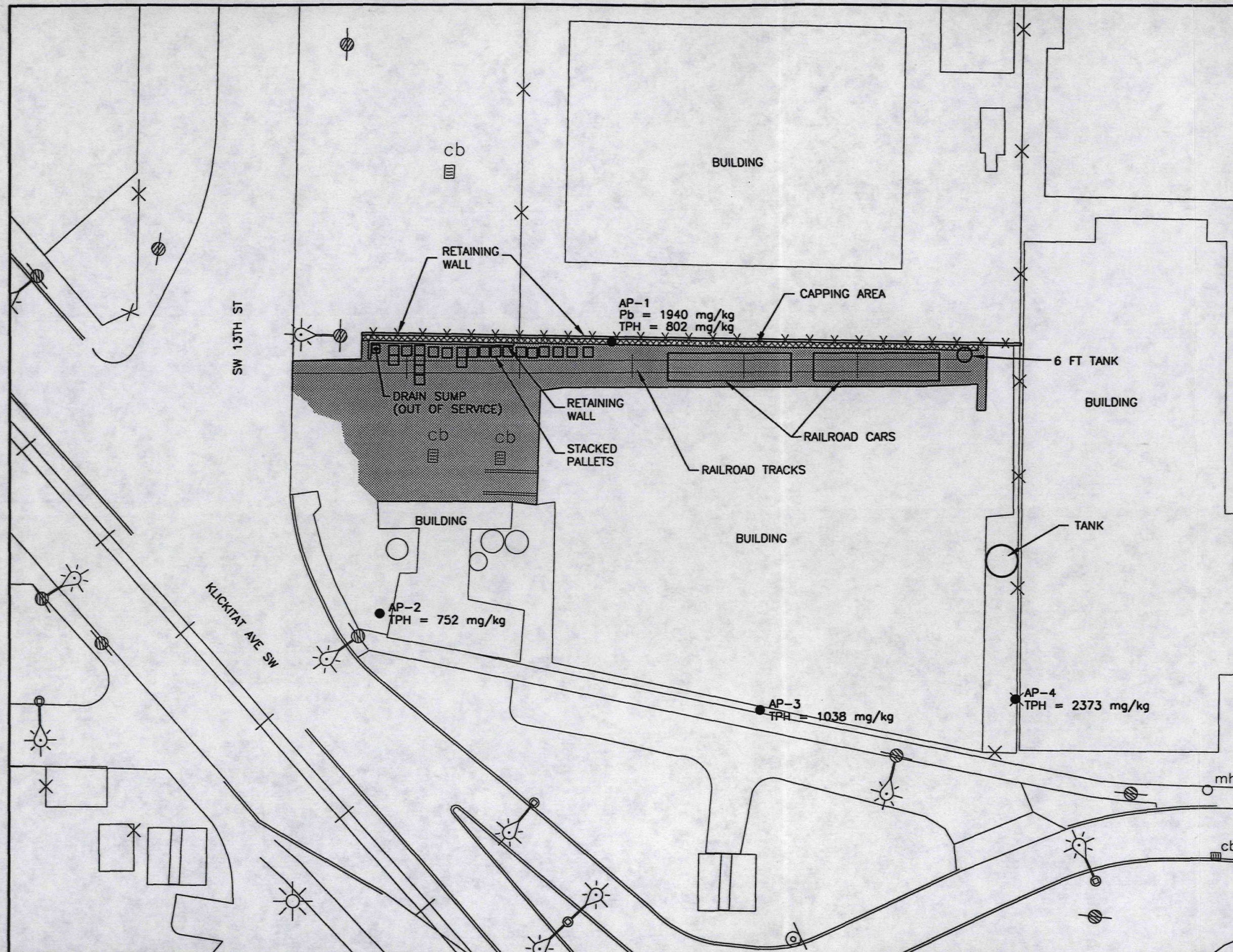
Site Preparation

Currently the west end of the strip of soil to be capped is covered by stacks of pallets. Two rail cars are stored on the rail spur adjacent to the strip near the middle and a six foot diameter upright tank is on the strip near the east end. Prior to beginning subgrade preparation, the pallets and tank will be relocated away from capping activities by either Aspen Paints personnel or the by the Contractor under direction of Aspen Paints personnel.

Subgrade preparation prior to capping will include removing the surficial soil from the strip to a depth of approximately 8 inches below ground surface (bgs). Soil removed during subgrade preparation will be stockpiled in a designated area on plastic sheeting or in a roll-off container and covered to keep it dry and prevent erosion.

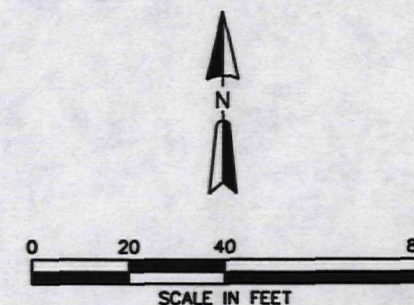
Subgrade Soil Disposition

Once the subgrade is prepared, a representative composite sample will be taken from the stockpiled soil for disposition profiling purposes. Based upon analytical results, the soil will be transported to an appropriate receiving facility. The soil may be combined with soil from other 1B sites prior to transportation to the receiving facility to reduce the cost of final disposition. This will be dependent upon the soil profiling results. Sample AP-1 collected from this area exceeded capping criteria for TPH and lead.



LEGEND

- SOIL STRIP TO BE CAPPED WITH 3" ACP
- SUIABLE EXISTING PAVEMENT
- APPROXIMATE SAMPLE LOCATION
- EXISTING FENCE
- EXISTING LIGHTPOLE
- EXISTING UTILITY POLE
- EXISTING CATCH BASIN



NO	DATE	REVISION	CHKD	DATE	APPVD	DATE
6						
5						
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2						
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0	E.F.	6/16/97	DRAFT			
	NO	DRWN	DATE	REVISION	CHKD	DATE

HARBOR ISLAND S&GOU
SUPERFUND SITE, SEATTLE, WA
1-2900-625

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CURRENT DATE: 6/16/97 CAD FILE: 2900S025

PROPOSED CAPPING AREA
ASPEN PAINTS

RETEC
REMEDIATION
TECHNOLOGIES INC.
DRAWING NO. 10
FIGURE 3-2

Base Course

Four (4) inches of crushed rock base course (CRBC) per Washington State Department of Transportation (WSDOT) specifications, will be used to backfill the excavation to 4 inches below grade. Placement of CRBC will be performed in accordance with WSDOT specifications and quality control requirements discussed in Section 5.

Capping

The cap will consist of a 4-inch layer of PCCP per WSDOT specifications and EPA requirements. Quality control requirements are discussed in Section 5. The top of the new PCCP surface will match the existing adjacent grades of the PCCP on either side of the exposed soil strip.

3.2.2 Union Pacific Railroad Parcel A Property

While capping of landscape planter areas is not proposed on any of the other 1B sites, it appears that the only RI sample obtained on this site was from a planter area. Therefore, capping on this property will be completed in a planter box and an exposed area near the old shed.

Design Rationale

Only one sample was collected from this property. The exact sample location is not known because the sampling log was not included in the RI sampling logs provided by EPA. However, based on maps in the RI, this sample appears to have been taken from the planter box on the northwest side of the building as shown in Figure 3-3. This sample exceeded capping criteria for arsenic and PAHs.

The planter box and an area near the old shed (Figure 3-3) are the only unpaved areas on the site. The remainder of the site is covered with suitable ACP and PCCP. The planter area will be capped with PCCP due to compaction concerns and the area near the old shed will be capped with ACP.

Site Preparation

Site and subgrade preparation will include removing the plants from the planter box, no soil will be removed. In the area to be capped by the old shed, soil will be removed to a depth of approximately 7 inches below the existing grade of the surrounding pavement. Soil removed during subgrade preparation will be stockpiled in a designated area on plastic sheeting or in a roll-off container and covered to keep it dry and prevent erosion.

Subgrade Soil Disposition

Once the subgrade is prepared, a composite sample will be taken from the stockpiled soil for disposition profiling purposes. Based upon analytical results, the soil will be transported to the appropriate receiving facility. The soil may be combined with soil from other 1B sites prior to transportation to the receiving facility to reduce the cost of final disposition. This will be dependent upon the soil profiling results. Sample PT-54 collected at the site exceeded capping criteria for arsenic and PAHs.

Base Course

CRBC per WSDOT specifications will be used to fill the planter to 4 inches below the top of the curb and compacted prior to placement of PCCP. Four (4) inches of CRBC per WSDOT specifications will be used to backfill the subgrade to 3 inches below final grade in the area by the old shed. Placement of CRBC will be accomplished in accordance with WSDOT specifications and quality control requirements discussed in Section 5.

Capping

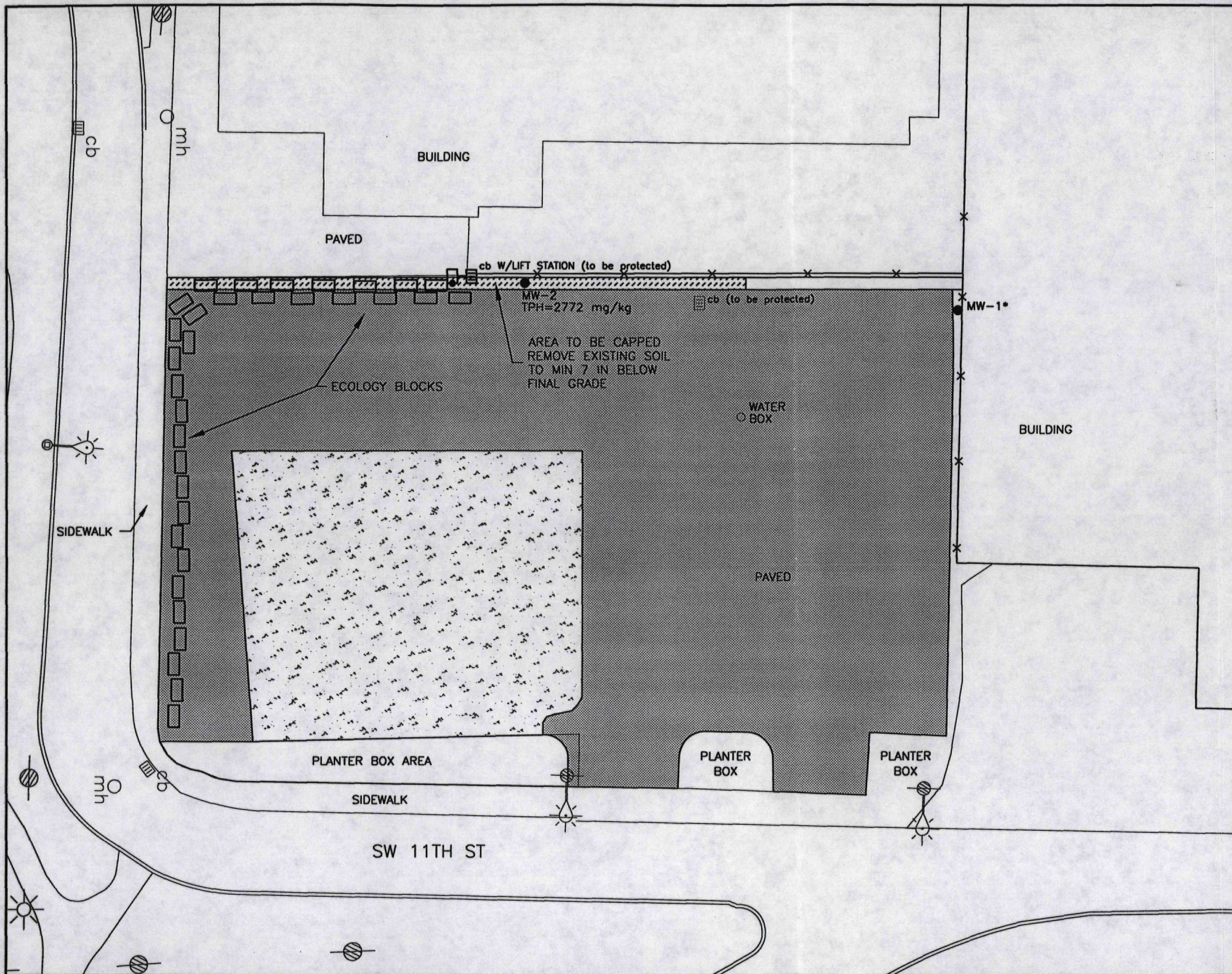
The cap for the planter box will consist of a 4-inch PCCP layer and the cap near the shed will consist of a 3-inch layer of ACP per WSDOT specifications and EPA requirements. Quality control requirements are discussed in Section 5. The top of the new PCCP surface in the planter box will match the top of the existing concrete curb and will be graded to prevent ponding and flow of water toward the building. The final grade of the exposed area by the shed will match the existing grade of the surrounding pavement. An emulsion asphalt tack coat will be placed on both sides of the existing cap prior to placing the ACP to ensure adequate adhesion between the new and existing caps. Joint sealer will be applied to the joint between the new cap and existing ACP on the west side of the Area 2 cap following placement of the asphalt.

3.2.3 Harbor Island Machine Works Property

The remedial action for this property will consist of capping a strip of soil running north and south along the west property boundary. The strip of soil is 175 feet long and ranges from 3 to 5 feet in width.

Design Rationale

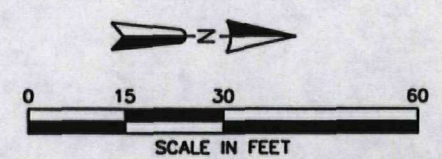
Two samples (MW-1 and MW-2) were collected from this property from locations shown in Figure 3-4. Sample MW-2 was the only location to be recorded in the EPA Sampling Summary (EPA, 1994). This sample exceeded capping criteria for TPH.



LEGEND

- SOIL STRIP TO BE CAPPED WITH 3" ACP. MATCH GRADE OF EXISTING ADJACENT PAVEMENT
- SUIABLE EXISTING PAVEMENT
- EXISTING COMPACTED GRAVEL
- APPROXIMATE SAMPLE LOCATION
- EXISTING FENCE
- EXISTING LIGHTPOLE
- EXISTING UTILITY POLE
- EXISTING CATCH BASIN
- EXISTING MANHOLE

* CONSTITUENT CONCENTRATIONS IN SAMPLE WERE BELOW EPA CAPPING CRITERIA.



REFERENCE DWG	DESCRIPTION	NO	DRWN	DATE	REVISION	CHKD	DATE	APPVD	DATE
0	E.F.	4/16/97	DRAFT						
1									
2									
3									
4									
5									
6									

**HARBOR ISLAND S&GOU
SUPERFUND SITE, SEATTLE, WA
1-2900-240**

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CURRENT DATE: 4/16/97 CAD FILE: 24995215

**PROPOSED CAPPING AREA
HARBOR ISLAND MACHINE WORKS**

RETEC
REMEDIAL
TECHNOLOGIES INC.

DRAWING NO. 187V
FIGURE 3-4 0

Because both samples were taken from the same strip of soil, the area impacted by TPH is well defined around the MW-2 sample location. Capping will begin halfway between the north and south sample (65 feet north of MW-2)and extend south 175 feet. No capping or repairs will be completed in the parking area because the existing pavement provides an effective barrier against dermal contact. The southeast corner of the property contains a compacted gravel surface.

Site Preparation

Ecology blocks are located on the south half of the strip of soil to be capped. Also, stacks of pallets are stored on the northern 25 feet of the soil strip. Prior to beginning subgrade preparation, the pallets will need to be relocated away from capping activities by either Harbor Island Machine Works personnel or the by the Contractor under direction of Harbor Island Machine Works. The ecology blocks will be move away from the capping area by the contractor. Any soil on the ecology blocks shall be removed prior to moving the blocks from the work area. Site and subgrade preparation prior to capping will include removing the vegetation and grading and compacting the surficial soil strip to be capped. The remaining soil will be graded to a depth of approximately 7 inches below existing grade on either side of the soil strip. Any soil removed during subgrade preparation will be stockpiled in a designated area on plastic sheeting or in a roll-off container and covered to keep it dry and prevent erosion.

Subgrade Soil Disposition

Once the subgrade is prepared, a representative composite sample will be taken from the stockpiled soil for disposition profiling purposes. Based upon analytical results, the soil will be transported to an appropriate receiving facility. The soil may be combined with soil from other 1B sites prior to transportation to the receiving facility to reduce the cost of final disposition. This will be dependent upon the soil profiling results. Sample MW-2 collected from this location exceeded capping criteria for TPH only.

Base Course

Four (4) inches of CRBC per WSDOT specifications will be used to backfill the excavation to 3 inches below final grade. Placement of CRBC will be accomplished in accordance with WSDOT specifications and quality control requirements discussed in Section 5.

Capping

The cap will consist of a 3-inch layer of ACP per WSDOT specifications and EPA requirements. Quality control requirements are discussed in Section 5. The top

of the new ACP surface will be sloped from the fence line or property boundary, depending upon the location, eastward to the existing ACP grade. The top of the new ACP surface will match the existing adjacent grades on either side of the exposed soil strip. An emulsion asphalt tack coat will be placed on both sides of the existing ACP cap prior to pouring the asphalt to ensure adequate adhesion between the new and existing caps. Joint sealer will be applied to the joint between the new cap and existing ACP surfaces following placement of the asphalt. Site storm water will continue to be collected and conveyed off-site through the existing storm water collection system.

3.2.4 Fisher Mills Property

The EPA required remedy at this site includes placement of ACP and associated stormwater collection systems necessary for newly paved areas around railroad tracks, replacement of unsuitable asphalt in railroad track areas and replacement of unsuitable concrete in the parking lot area. Capping will be conducted throughout the active rail bed areas from the east property boundary to near the west property boundary (see Figure 3-1).

Design Rationale

Two samples were collected from this property at locations shown in Figure 3-5. Sample FM-07 was the only location to be recorded in the EPA Sampling Summary (EPA, 1994). This sample exceeded capping criteria for TPH and PAHs.

The area to the south of sample location FM-07 is a concrete parking lot. South of the parking lot is an asphalt roadway. Both are suitable existing pavements. In the north section of the parking lot the concrete slab is broken and water ponds in the northwest corner. The concrete will be removed, the area will be regraded and a new ACP surface will be placed.

Site Preparation

Site and subgrade preparation activities will include:

- Removing any existing asphalt in the active rail bed areas
- Clearing and grubbing surficial soil from the proposed capping areas around the tracks
- Removing broken and settled concrete in the parking lot

Appendix A

Request for Bid

REQUEST FOR BID
SITE CAPPING - DESIGN SET 1B
HARBOR ISLAND S&G OU SUPERFUND SITE

BID FORMS

Date

To: Harbor Island S&G OU 1B Participants
c/o RETEC
1011 SW Klickitat Way, #207
Seattle, Washington 98134

1. Bid: Having carefully examined the contract documents titled:

REQUEST FOR BID
SITE CAPPING - DESIGN SET 1B

and the drawings similarly titled, as well as the site of the project and conditions affecting the work, the undersigned proposes to furnish all the labor, materials, equipment, superintendence, insurance and other accessories and services necessary to perform and complete all of the work required by and in strict accordance with the above documents and the implied intent thereof, for the following schedule of prices:

ASAHIPEN AMERICA (ASPEN PAINTS)

SCHEDULE OF UNIT PRICES

ITEM NO.	ITEMS OF WORK	BID QTY.	UNITS	UNIT PRICES		AMOUNT	
				DOLLARS	CTS	DOLLARS	CTS
1	Mobilization, Site Preparation	1	ls				
2	Subgrade Preparation / Grading	1	ls				
3	Soil Stockpiling and Loading	1	ls				
4	CRBC and PCCP	400	sq ft				
5	Soil Transportation and Disposal	14	ton				

TOTAL ASPEN PAINTS BID PRICE

(Figures)

(Words)

SCHEDULE OF UNIT PRICES

B. Union Pacific Railroad Parcel A

ITEM NO.	ITEMS OF WORK	BID QTY.	UNITS	UNIT PRICES		AMOUNT	
				DOLLARS	CTS	DOLLARS	CTS
1	Mobilization, Site Preparation	1	ls				
2	Clearing, Subgrade Preparation	1	ls				
3	CRBC and ACP	110	sq ft				
4	CRBC and PCCP	60	sq ft				
5	Soil and Debris Stockpiling and Loading	1	ls				
6	Soil Transportation and Disposal	5	ton				
7	Debris Transportation and Disposal	1	ton				

TOTAL UPRR PARCEL A BID PRICE _____

(Figures)

(Words)

SCHEDULE OF UNIT PRICES

C. Harbor Island Machine Works

ITEM NO.	ITEMS OF WORK	BID QTY.	UNITS	UNIT PRICES		AMOUNT	
				DOLLARS	CTS	DOLLARS	CTS
1	Mobilization, Site Preparation	1	ls				
2	Subgrade Preparation / Grading	1	ls				
3	CRBC and ACP	700	sq ft				
	Soil and Debris Stockpiling and Loading	1	ls				
4	Soil Transportation and Disposal	24	ton				
5	Debris Transportation and Disposal	2	ton				

TOTAL HI MACHINE WORKS _____

(Figures)

(Words)

SCHEDULE OF UNIT PRICES

D. Fisher Mills

ITEM NO.	ITEMS OF WORK	BID QTY.	UNITS	UNIT PRICES		AMOUNT	
				DOLLARS	CTS	DOLLARS	CTS
1	Mobilization & Site Preparation	1	ls				
2	Subgrade Preparation-Rail Bed Areas	1	ls				
3	Slab Demolition and Subgrade Preparation-Parking Lot Area	4,625	sq ft				
4	Track and Structural Demolition	1	ls				
5	Storm Drain System Improvements	1	ls				
6	Track Construction	2,300	t. f.				
7	CRBC and ACP - Rail Bed Area	38,950	sq ft				
8	CRBC and ACP - Rail Bed Dump Pit Area	6,700	sq ft				
9	Railroad Track Ballast - Rail Bed Area	1,150	ton				
10	CRBC and ACP - Parking Lot	4,625	sq ft				
11	Structural Modifications	1	ls				
12	Debris Stockpiling and Loading	300	cy				
13	Soil Stockpiling and Loading	1,350	cy				
14	Soil Transportation and Disposal	1,350	cy				
15	Debris Transportation and Disposal	600	ton				

TOTAL FISHER MILLS BID PRICE _____

(Figures)

(Words)

SCHEDULE OF UNIT PRICES

E. Former Lone Star NW

ITEM NO.	ITEMS OF WORK	BID QTY.	UNITS	UNIT PRICES		AMOUNT	
				DOLLARS	CTS	DOLLARS	CTS
1	Mobilization, Site Preparation	1	ls				
2	Subgrade Preparation/Grading	1	ls				
3	Soil Stockpiling and Loading	1	ls				
4	CRBC and PCCP	240	sq ft				
5	ACP Overlay	400	sq ft				
6	Soil Transportation and Disposal	9	ton				

TOTAL FORMER LONE STAR NW BID PRICE _____
(Figures)

(Words)

2. State and Local Sales Tax: Applicable state and local sales tax and B&O tax have been included in the bid prices stated above.
3. Completion Under Base Bid: The undersigned agrees to complete all of the work included in this contract within thirty (30) calendar days as provided for in the Contract Documents.
4. Legal Representation: In all legal matters relating to this contract, the undersigned will be represented by:

5. Bid Withdrawal: The above bid will not be withdrawn within sixty (60) days after the actual date of the opening thereof.
6. By submission of this bid, each bidder certifies, and in the case of a joint bid each party thereto certifies as to his own organization, that this bid has been arrived at independently, without consultation, communication, or agreement as to any matter relating to this bid with any other bidder or with any competitor.

FAILURE OF A BIDDER TO SUBMIT THE FORMS WITH HIS BID, EXECUTED WHERE
REQUIRED, MAY DISQUALIFY THE BID.

SEAL
(if a Corporation)

Contractor _____

An Individual Proprietor
A Partnership
A Corporation
A Joint Venture

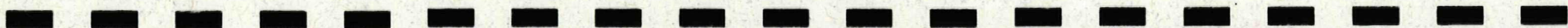
Washington State Reg. No. _____ since _____, expires _____
date date

By _____
NAME (PLEASE PRINT) (TITLE) Name Partners (if a Partnership):

SIGNATURE

Address _____

Phone No. _____ Zip Code _____





Appendix B

Specifications

**SPECIFICATIONS
SITE CAPPING - DESIGN SET 1B
HARBOR ISLAND S&G OU SUPERFUND SITE**

GENERAL CONDITIONS

1. Qualification of Bidders

- A. The Harbor Island Superfund Site Soil and Groundwater Operable Unit (S&G OU) has prequalified contractors prior to soliciting Bids. However, the S&G OU may make further investigations as deemed necessary to determine the ability of the Bidder to perform the Work. The Bidder shall furnish to the S&G OU all such information and data for this purpose as the S&G OU may request. The S&G OU reserves the right to reject any Bid if the evidence submitted by, or investigation of, such Bidder fails to satisfy the S&G OU that such Bidder is properly qualified to carry out the obligations of the contract and to complete the Work contemplated therein.
- B. The Bidder must be familiar with all federal, State and local laws, including RCW 18.27 Registration of Contractors, ordinances and regulations which in any manner might affect those engaged or employed in the Work, the materials, equipment or procedures used in the Work. It is assumed the Bidder is familiar with such laws and regulations, and no plea of misunderstanding or ignorance of the law will be considered.

2. Bidder's Representation

Each Bidder, by submitting a Bid, represents that:

- A. The Bidder has read and understands the Bid Documents and that the Bid is made in accordance with all applicable documents.
- B. The Bidder has inspected or investigated the site(s) of the Work and has become familiar with the local conditions under which the Work is to be performed and has familiarized itself with the quantity and character of all Work.
- C. The Bid is based upon the Work described or presented within the Bid Documents and Drawings.

- D. The failure or omission of the Bidder to examine all pertinent forms, instruments, applicable statutes, or other documents shall in no way relieve the Bidder from the contractual obligations required by the Bid Documents.
- E. The Bid submitted is unconditional in all respects.

3. Bid Documents

Availability

- A. Copies of the Bid Documents and Drawings will be mailed to selected bidders.
- B. Additional copies of the Bid Documents and Drawings may be obtained from RETEC (contact Bryan Stone, 206-624-9349).
- C. Only complete sets of Bid Documents will be issued and complete sets shall be used in preparing bids. The S&G OU assumes no responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bid Documents.
- D. Bid Documents issued as stated above are for bidding purposes only. The S&G OU does not confer a license or grant for any other use.

Interpretation & Clarification

- A. Bidders shall promptly notify the S&G OU of ambiguities, inconsistencies, or errors, if any, which they may discover upon examination of the Bid Documents or of the site and local conditions.
- B. Interpretations and Clarifications:
 - 1. Every request for interpretation or clarification should be made to Mr. Bryan Stone, RETEC, 1011 SW Klickitat Way, Suite 207, Seattle, Washington 98134. To be given consideration the request must be received three (3) working days prior to the date fixed for the opening of the bids or proposals.
 - 2. The S&G OU's responses, if there are any, be mailed, delivered, telegraphed or faxed to all plan holders of record, at the respective address furnished for such purposes, prior to the date fixed for the receipt of bids. Such letters of clarification shall not be considered part of the contract documents and therefore need not be acknowledged by the bidders as part

of the Bid Form. The S&G OU will determine at its sole discretion whether or not any clarification or interpretation changes the Scope of Work and should be included in the Contract Documents.

3. Oral interpretations or clarifications will be without legal effect.

Additional Information Provided By The S&G OU

The following documents are available at RETEC's office for bidder's inspection and information:

- A. Remedial Investigation and Feasibility Study (Weston, 1994)
- B. Design Set 1B, Final (100%) Design Document (RETEC, 1997)

Examination of the Work Site and Contract Documents

The Contractor may make a pre-bid examination of the site by contacting Bryan Stone at RETEC, telephone number (206) 624-9349.

- A. The first pre-bid examination of the site will be a common examination for all bidders and will be held _____, 1997 at 10:00 a.m. Bidders shall park their vehicles outside of the Fisher Mills office building at 1733 SW Klickitat Way, Seattle, where they will be met and escorted by Bryan Stone.
- B. Bidders may attend a second pre-bid examination of the site by contacting Bryan Stone. The second pre-bid examination will be _____, 1997 at 10:00 a.m.

4. Insurance Requirements

Insurance Certificates

Prior to the execution of the Contract, the Bidder shall furnish in a form satisfactory to the S&G OU, the necessary Insurance Certificates.

Insurance Coverage

The Contractor shall, at its sole expense, obtain and keep insurance of the following types and minimum coverage until completion of the Work.

<u>Type of Policy</u>	<u>Minimum Coverage</u>
Worker's Compensation	\$1,000,000 per accident-disease
Comprehensive General Liability	\$1,000,000 combined single limit per occurrence
Automobile Liability	\$1,000,000 combined single limit per occurrence

5. Execution of Bid

- A. Bids shall be submitted on the forms provided by the S&G OU.
- B. All blanks on the Bid Form shall be filled in by typewriter or printed by hand in ink.
- C. For lump sum Bids the total Contract lump sum price shall be submitted.
- D. Where so indicated by the makeup of the Bid Form, sums shall be expressed in both words and figures, and in case of discrepancy between the two, the amount written in words shall govern.
- E. For unit price Bids a price shall be submitted for each item of the Work, an extension thereof, and the total amount bid. Such prices shall be stated in clearly legible figures only and shall be in ink or typed.
- F. Alterations, erasures, or interlineations, if any, shall be in ink and initialed by the signer of the Bid.
- G. The Bidder shall make no additional conditions or stipulations on the Bid or qualify his Bid in any manner.
- H. The Bid Form shall include the legal name and registration number of the Bidder and a statement indicating whether Bidder is a sole proprietor, a partnership, a corporation, joint venture, or other legal entity. The Bid Form shall be signed by the person or persons legally authorized to bind the Bidder to a contract and shall be accompanied by satisfactory evidence of such authorization. A Bid by a corporation shall further give the State of incorporation and have the corporate seal affixed. A Bid submitted by an agent shall have a current Power of Attorney attached certifying agent's authority to bind the Bidder.

- I. The Bid Form shall not become a part of the Contract Documents except by inclusion into the Agreement.

6. Acceptance of Bid (Award)

Verification of Bid Prices: All bids will be checked for mathematical accuracy with respect to the extensions of unit bid prices and the total Bid price. If there is a discrepancy between a unit Bid price and the extended amount of any Bid item, the unit Bid price shall control. The total of extensions, corrected where necessary, will be used as the amount of the Bid for award purposes and will fix the amount of the Contract bonds.

Rights of the S&G OU:

- A. The S&G OU shall have the right to waive any informality or irregularity in any Bid received.
- B. The right is reserved to accept a Bid of the lowest responsible Bidder, an Alternative Bid based upon plans and specifications prepared by the Bidder, to reject any or all Bids, republish the call for Bids, revise or cancel the work to be performed, or to do the work otherwise, if in the judgement of the S&G OU, the best interest of the S&G OU is served thereby.
- C. Bidders are advised that regulations governing the permit application and approval process are becoming so complex and uncertain as to results that this project may not receive the approval of all regulatory agencies and therefore may not be awarded to any bidder, notwithstanding that the price offered is within the budget approved by the S&G OU.

Failure to Execute Contract: If the Bidder awarded the Contract fails to execute the Contract and furnish satisfactory bonds within ten (10) days from receipt of award, or declares in writing his intent to not execute the Contract, the S&G OU may award the Contract to the second lowest responsible Bidder. If the second lowest responsible Bidder fails to enter into the Contract and furnish bonds within ten (10) days after receipt of award to him, the Contract may be awarded to the third lowest responsible Bidder, and in like manner until the Contract and bonds are executed by a responsible Bidder to whom award is made, or further Bids are rejected or the number of Bids is exhausted.

Notice of Award: The successful Bidder will receive a "Notice of Award" by Certified or Express Mail. The letter will direct the Bidder to submit certificates of insurance, and the required bonds for review and approval within ten (10) days

after receipt. The Bidder shall also execute the Agreement form, furnished by the S&G OU, within ten (10) days after the receipt of "Notice of Award."

Extension of Time: If the Contract is not executed or not provided within the time required, and there appears circumstances which the S&G OU deems to warrant an extension of time, it may extend the time for execution of the Contract or for furnishing bonds for not to exceed ten (10) additional days.

Signing of the Contract: Copies of Contract Documents shall be signed by the S&G OU and the Contractor.

Cancellation of Award: The S&G OU reserves the right to cancel the award of any Contract at any time before the execution of said Contract by all parties without liability to the S&G OU.

7. Form of Agreement

The Contract for Work will be executed on the S&G OU's standard Agreement form, a sample of which is attached, for Work between the S&G OU and the Contractor.

8. Post-Bid Information

Required Submittals:

- A. Within seven (7) days after receipt of Notice of Award, the Bidder shall submit the following information to the Engineer:
 - 1. A designation of the Work to be performed by the Bidder with his own forces.
 - 2. The proprietary names of the principal items, systems, and material to be incorporated into the Work and the names and addresses of their suppliers.
 - 3. A list containing the name and address of the proposed superintendent, major subcontractors, or other persons or organizations proposed for the principal portions of the Work.
- B. Before a Contract is awarded, the Bidder being considered for award may be required to furnish a complete statement as to the origin, composition and manufacture of materials to be used in the construction of the Work, together

with samples, which samples may be subjected to tests to determine their quality and fitness for the Work as provided under the Contract.

C. Other required submittals are described elsewhere in these specifications.

GENERAL REQUIREMENTS

1. Compliance With S&G OU Consent Decree

The work includes the requirements for Contractor compliance with the S&G OU's Consent Decree Civil Action Number C95-1495-Z (CD) from EPA, including performance of the work, notifications and reporting. A copy of the CD is attached.

Definitions

S&G OU: Soil and Groundwater Operable Unit of the Harbor Island Superfund Site

ROD (Record of Decision): The Record of Decision relating to the Harbor Island Soil and Groundwater Operable Unit of the Harbor Island Superfund Site issued in March 1994, by the Regional Administrator, EPA Region 10, and all attachments thereto.

Oversight Engineer: Engineer responsible for ensuring that Remedial Actions are performed in accordance with performance standards.

RI/FS: Remedial Investigation and Feasibility Study prepared for the EPA by Roy F. Weston, Inc.

SOW (Statement of Work): The statement of work for implementation of the Remedial Design, Remedial Action, and Operation and Maintenance at the S&G OU, as set forth in Appendix B of the Consent Decree.

Performance Standards: Those cleanup standards, standards of control, and other substantive requirements, criteria or limitations set forth in the ROD and the SOW.

EPA Authority

EPA has the authority to control work on the site; and specifically has the following rights, regarding the Contractor and all its' subcontractors:

- A. EPA may disqualify any firm or any person from performing the Work that involves likely contact with hazardous soil or groundwater, based on their failure to meet technical background or experience requirements, or their lack of hazardous materials training.

- B. If, in EPA's judgement, unanticipated or changed circumstances on the site present a risk to human health or the environment, EPA may require a change to the Work under this Contract. If such unanticipated or changed circumstances on the site are the results of Contractor's negligence or of any Contractor activity not required by these Contract documents, the cost of EPA-initiated changes shall be borne by the Contractor.
- C. EPA shall be given access to the site whenever requested from Contractor, including access to Contractor's temporary facilities and Contractor's on-site project documents.

2. Submittals

Contractor shall submit a Health and Safety Plan and a Work Plan within 10 working days of Contract Award. The Work Plan shall include a project schedule, stockpiling plans, and decontamination procedures, including water containment, handling, and disposal. Submittals must be reviewed by the Oversight Engineer and EPA prior to commencing work.

3. Off-Site Shipment of Materials

All off-site shipments shall comply with EPA off-site policy rules. All receiving facilities shall be approved by EPA and Contractor shall notify Oversight Engineer at least 5 days prior to any off-site shipment.

4. Notifications

A. S&G OU Project Coordinator contact:

Anita Lovely (206) 368-2447
Project Coordinator
Lovely Consulting, Inc.
17171 Bothell Way NE
Suite 300
Seattle, WA 98155

B. S&G OU EPA Project Manager:

Keith Rose (206) 553-7721
EPA Project Coordinator
US EPA Region X
1200 Sixth Avenue, Mail Stop ECL-111
Seattle, WA 98101

C. Coordinating Contractor:
Mark Valentine
Coordinating Contractor
de maximis, inc.
705 Second Avenue, Suite 802
Seattle, WA 98104
(206) 682-1966

D. Oversight Engineer contact:
Bryan Stone, P.E.
Project Manager
RETEC
1011 SW Klickitat Way, Suite 207
Seattle, WA 98134
(206) 624-9349

- E. Contractor shall verbally notify the Oversight Engineer a minimum of 5 working days prior to performing any soil excavation or grading work.
- F. Contractor shall verbally notify the Oversight Engineer a minimum of 8 hours following discovery of any unanticipated or changed circumstances during the Work.
- G. Contractor shall notify in writing the Oversight Engineer a minimum of 5 working days prior to any off-site shipment. This notification shall include the waste type, estimated quantity, and the disposal or recycling facility. Use of the proposed facilities is subject to EPA approval.

5. Summary of Work

The overall scope of work is to provide subgrade preparation work and capping of limited soil areas that were determined during previous sampling and testing by EPA to contain constituents of concern in excess of EPA-defined capping criteria. Capping will include placement of 4 inches of crushed rock base course (CRBC) followed by a minimum of 3 inches (finished compacted thickness) of asphaltic concrete pavement (ACP), or 4 inches of Portland cement concrete pavement (PCCP), or 6 to 12 inches of crushed rock ballast or other approved material to serve as a barrier to dermal contact.

Work incidental to this shall include compliance with all applicable health and safety regulations, stormwater controls and stormwater management, overburden grading and soil stockpiling/handling, soil disposal, drainage improvements, and

construction equipment and personnel decontamination. ACP, PCCP, and CRBC materials and placement shall comply with Washington Department of Transportation (WSDOT) specifications.

The following is a summary of work to be performed at each of the sites that require capping as part of the S&G OU Design Set 1B. Engineer estimates of areas and volumes of work are included on the Bid Forms.

Aspen Paints

The Contractor shall prepare subgrade and cap a strip of exposed soil along the northern property boundary. Work includes removing the upper 8 inches of soil (approximately 8 cubic yards) from the defined capping area, placing and compacting 4 inches of CRBC, and placing a 4-inch lift of PCCP, as indicated on the drawings. Soil removed during subgrade preparation shall be temporarily stockpiled on site to be characterized by the Oversight Engineer prior to off site shipment by the Contractor.

Union Pacific Railroad Parcel A

The Contractor shall prepare subgrade and cap two areas of exposed soil. Contractor shall remove existing shrubs and grasses and remove existing soil to the appropriate depth below final grade. Contractor shall place and compact 4 inches of CRBC followed by a 3-inch lift of ACP or a 4-inch lift of PCCP, as indicated on the drawings. Soil generated during grading activities shall be temporarily stockpiled on site to be characterized by the Oversight Engineer prior to off site shipment by the Contractor.

Harbor Island Machine Works

The Contractor shall prepare subgrade and cap an area of exposed soil along the western property boundary. Work includes removing the upper few inches of soil from the area as indicated on the drawings, placing and compacting 4 inches of CRBC, and placing and compacting a 3-inch lift of ACP, as indicated on the drawings. Overburden grading soil shall be temporarily stockpiled on site to be characterized by the Oversight Engineer prior to off site shipment by the Contractor.

Fisher Mills

The contractor shall demolish existing railroad tracks 2, 3, and 4, demolish an existing concrete slab, upgrade drainage components, reinstall the railroad tracks,

and cap these disturbed areas with ACP. Work includes the excavation and removal of sufficient amounts of soil to reconstruct the railroad tracks and ballast, demolition of a large concrete slab currently used for parking, demolition of selected drainage components, installation of new drainage components, minor modifications to the structure above the tracks, and modifications to the under-track unloading pits. Paving shall consist of a minimum of 3 inches of compacted ACP over 4 inches of compacted CRBC. Excess excavated soil shall be temporarily stockpiled on site to be characterized by the Oversight Engineer prior to wasting on site in a vacant area on the north side of the Fisher property. Demolished ACP and PCCP shall have all soil and staining removed as directed by Oversight Engineer and shall be wasted on the north side of the property.

Former Lone Star Northwest

The Contractor shall prepare subgrade and cap an area of exposed soil along the north property boundary. Work includes removing the upper 8 inches of soil from the area, placing and compacting 4 inches of CRBC, and placing a 4-inch lift of PCCP, as indicated on the drawings. The Contractor shall also place an ACP overlay over existing PCCP on the south portion of the site as indicated on the drawings.

6. Health and Safety Requirements

Health and Safety Plan

Contractor shall submit a site-specific health and safety plan (HASP) for all nonhazardous and hazardous work to be performed on site. The constituents of concern previously detected at the 1B Participant properties include total petroleum hydrocarbons (TPH), polycyclic aromatic hydrocarbons (PAH), arsenic and lead.

The HASP must be reviewed for completeness by the Oversight Engineer and EPA prior to commencing the Work. For work that does not disturb native soil, the Contractor is not required to have workers trained for hazardous waste operations. For site work within native soil such as earthwork, grading, or storm drainage system improvements, the Contractor shall comply with the following hazardous waste operations requirements.

Minimum Requirements

The Remedial Contractor shall be required to meet all the requirements of Washington Administrative Code (WAC) 296-155, Safety Standards for

Construction and the applicable provisions of the hazardous waste operations regulations, WAC 296-62, Part P, and Occupational Safety and Health Administration requirements and EPA requirements for work on hazardous waste sites as defined in 29 CFR 1910.120. The Contractor shall also have a site health and safety (H&S) officer who will ensure that contractor personnel adhere to H&S regulations.

The plan shall also include written documentation of employee training and medical certifications as required under WAC 296-62, Part P. Documentation of the following items is required for each site worker where work falls under the requirements of WAC 296-62, Part P:

- Initial 40-hour health and safety training and annual 8-hour refresher training
- Eight-hour supervisory training, required for the field supervisor
- Medical clearance from a licensed physician certifying that the worker is fit to participate in field activities and use personal protective equipment
- Current respirator fit test certification
- Current CPR and first aid certification for at least one member of each crew
- Provision of personal protective equipment for each worker at the highest level of protection for this site

Submittal

A minimum of 10 working days Prior to commencing site work, the Contractor shall submit their own HASP for review by the Oversight Engineer and EPA.

Measurement and Payment

Health and safety shall not be measured separately. It shall be considered incidental to, and included in the various lump sum and unit price items.

7. Equipment and Personnel Decontamination

General

Decontamination shall be performed on all construction and field equipment prior to delivery to the site. The Contractor shall provide on-site decontamination for all construction-related equipment that contacts native soil prior to removing equipment from the site. The Contractor shall also perform decontamination during the course of work on any construction equipment that previously handled impacted material prior to that equipment handling clean material, and prior to moving equipment between IB capping sites being addressed within this Contract. The Contractor shall also provide decontamination facilities for on-site construction workers. The site shall be maintained in a clean and orderly fashion to prevent tracking or off-site migration of impacted soil.

Equipment Decontamination Area

- A. An equipment and personnel decontamination facility shall be configured to collect and contain all liquids and solids.
- B. Splash protection shall be provided around the decontamination facility. Splash protection shall minimize potential contamination from splatter and mist during the equipment decontamination process.
- C. A drainage and collection system shall be provided for wastewater generated during decontamination procedures.

Decontamination Residuals

Decontamination wastewater shall be containerized, characterized and disposed off-site at a licensed treatment, storage and disposal (TSD) facility. Decontamination soil and sludges shall be collected and disposed in the same manner as overburden grading soil. Any PPE utilized during the remedial action shall be properly containerized and disposed by Contractor.

Decontamination Methods

The equipment cleaning process shall consist of a high pressure water or steam washing of the equipment (backhoe bucket, etc.). The cleaning process shall be of sufficient temperature, pressure, residence time, and agitation to remove contaminated waste from equipment or other surfaces. The use of surfactants or detergent shall be at the sole discretion of the Contractor. Personnel

decontamination shall be performed in accordance with the Contractor Health and Safety Plan.

Measurement and Payment

Decontamination of equipment and personnel shall not be measured separately. It shall be considered incidental to, and included in the various lump sum and unit price items.

8. Quality Control; Testing Laboratory Services

General

All of the Work under this Contract must be tested and inspected in accordance with the testing methods, procedures and frequency as summarized in Table A-1. The Contractor shall furnish all labor, equipment, and materials for initial testing of the CRBC, other import fill, ACP and/or PCCP mix designs as applicable.

Materials To Be Tested And Inspected By The Contractor

Inspection, sampling, and testing necessary to provide compliance with the requirements of these specifications shall include, but not be limited to, the following:

- A. Imported base course materials.
- B. ACP and PCCP mix designs, including composition and permeability data.

Services of Independent Testing Laboratory

It shall be the Contractor's responsibility to obtain and pay for the services of one or more approved independent laboratories as specified to take all samples and perform all tests and inspections necessary for initial approval of materials. No materials shall be placed without prior acceptance by the Engineer.

Submittals

The Contractor shall furnish certified copies of all tests to the Engineer.

Measurement and Payment

Quality control shall not be measured separately. It shall be considered incidental to, and included in the related unit prices for paving (CRBC, ACP, and PCCP).

SITE WORK REQUIREMENTS

1. Clearing, Grubbing, and Site Preparation

General

The Contractor shall remove any structures, debris, shrubbery, or grasses from areas to be capped. Structures and debris shall be removed and relocated within the work area as indicated on the drawings. Structures and debris may include wooden pallets, ecology blocks, and other miscellaneous material. Shrubby and grasses shall be stockpiled and disposed of as solid waste refuse at an approved Subtitle D or equivalent facility. Asphalt or concrete rubble may be recycled if approved by the Engineer. No existing pavement is anticipated to be impacted by work under this contract except limited areas at Fisher Mills.

Measurement and Payment

Payment for Clearing, Grubbing, and Site Preparation shall be included in the lump sum costs for Mobilization, Site Preparation. This payment will be full compensation for furnishing all labor, materials, and equipment required for Clearing, Grubbing, and Site Preparation.

2. Subgrade Preparation

General

Subgrade shall be prepared, as indicated in the drawings for each site, to allow placement of the specified thicknesses of CRBC and ACP or PCCP surfaces. Unless otherwise indicated on the drawings, the surface of all finished capping areas shall be flush with adjacent existing grades.

The Contractor shall compact all native surfaces after cut/fill grading as follows:

Fill Areas: Compact all fill areas to 95 percent Standard Proctor density. Place soil in maximum 8 inch loose lifts prior to compaction.

Cut areas: Compact all cut areas with a minimum of two passes of a vibratory roller to satisfaction of the Oversight Engineer. If the Contractor over excavates cut surfaces greater than 4 inches deeper than specified in the drawings and requires subsequent filling, the area shall be considered a "fill area" for purposes of compaction. Any additional backfill necessary due to overexcavation beyond

the required depth shall be backfilled and compacted at the Contractor's own expense.

Measurement and Payment

Payment for Subgrade Preparation shall be included in the lump sum costs for Subgrade Preparation/Grading. This payment will be full compensation for furnishing all labor, materials, and equipment required for subgrade Preparation.

3. Handling, Transportation, and Disposal of Soil and Debris

Stockpiling

Excavated soil and debris shall be placed in separated lined and covered stockpiles or roll-off containers as indicated on the drawings. The liner shall be a minimum 10 mil HDPE and the cover shall be a minimum 10 mil HDPE. Stockpiles may be placed on pavement without a liner as approved by Oversight Engineer. Roll-off containers shall be covered to prevent rainwater from infiltrating and to prevent dust generation. Stockpiles from separate sites may be consolidated following profiling as approved by Oversight Engineer. Stockpiles shall be inspected daily, at a minimum, to ensure integrity of the cover and liner are maintained.

Transportation

Contractor shall provide all equipment, personnel, and facilities necessary to load and transport waste in accordance with 49 CFR 171 through 177. Vehicles used by Contractor to transport wastes shall be properly designed, equipped, and maintained to prevent leakage and spillage of soil and debris during transport. Vehicle operators shall be trained and licensed in conformance with Federal and State regulations for the hauling of non-hazardous or hazardous waste. Contractor shall be responsible for any and all actions to remediate spills in transit. Contractor shall be responsible for obtaining permits and authorizations necessary to use the selected shipping routes.

Disposal

It is anticipated that soil and debris generated during capping activities may be disposed at a Subtitle D landfill. Contractor must provide the name and location of the disposal facility included in the Work Plan. Any Subtitle C disposal facility must be approved by EPA in accordance with the Off-Site Policy Rule.

Measurement and Payment

Payment for Handling, Transportation, and Disposal of Soil and Debris shall be included in the lump sum costs for Soil Stockpiling and loading and the unit price costs for Soil Transportation and Disposal. This payment will be full compensation for furnishing all labor, materials, and equipment required for Handling, Transportation, and Disposal of Soil and Debris.

4. Storm Water and Decontamination Water Handling

Storm Water

It is anticipated that no storm water will be collected during site capping activities. Any storm water collected shall be collected and disposed at the Contractor's expense. Contractor shall implement Best Management Practices to control Storm water runoff and runoff.

Decontamination Water

Decontamination wastewater shall be containerized, characterized and disposed off-site at a licensed treatment, storage and disposal (TSD) facility. Decontamination soil and sludges shall be collected and disposed in the same manner as overburden grading soil.

Measurement and Payment

Storm Water and Decontamination Water Handling shall not be measured separately. It shall be considered incidental to, and included in the various lump sum and unit prices.

5. Storm Drain Systems

Contractor shall demolish, repair, and upgrade the storm system at Fisher Mills as indicated on the drawings.

Demolition

Unless otherwise indicated, all items designated to be demolished shall be removed completely and be disposed of off-site by the contractor at an approved site. Where catch basins or manholes are to be removed, completely remove the structure and remaining pipe. Backfill and compact per Section 2, Subgrade Preparation.

Trenching

Trenches shall conform to the trench detail shown on the plans.

Piping

All storm system piping shall be cement-lined, rubber-gasketed ductile iron pipe (DIP) of thickness class 50 or better. Fittings shall be rubber-gasketed cast iron. All DIP and fittings shall conform to all applicable AWWA specifications.

Pipe Bedding

Pipe bedding shall conform to WSDOT specifications for pipe bedding for rigid pipe.

Catch Basins

Catch basins shall be WSDOT Type 1 (Standard Plan B-1) catch basins with standard cast iron frames and grates (Standard Plan B-2A). Catch basins shall be placed on a 6 inch thick compacted layer of crushed rock.

Slot Drains

Slot drains shall be manufactured from 14 gage corrugated steel pipe which has been galvanized or aluminized per WSDOT specifications. The corrugated steel pipe shall have a minimum of two rerolled annular ends to facilitate connections. The slotted drain bands shall be modified HUGGER Bands to secure the pipe and prevent infiltration of backfill. When the slotted drain is banded together, the adjacent grates shall have a maximum gap of 3 inches.

The grates shall be 6 inches high, trapezoidal in shape with a 1 3/4-inch opening in the top and 30° slanted spacer plates. The grate and spacers shall be 3/16 inch ASTM Grade 36 steel. The spacer plates shall be on 6-inch centers and welded on both sides to each bearing plate (sides) with four 1 1/4-inch-long 3/16-inch fillet welds on each side of the bearing plate. Grates shall be galvanized in accordance with ASTM A 123 except with a 2-ounce galvanized coating. The grate shall be fillet welded a minimum 1-inch long to the CSP on each side of the grate at every other corrugation.

Vertical bow tolerance is $\pm 3/8$ inch. Horizontal bow tolerance is $\pm 5/8$ inch. Twist tolerance is $\pm 1/2$ inch.

6. Base Course

General

CRBC shall be placed to the lines and grades indicated on the drawings. The CRBC shall be placed in a single lift and compacted with a mechanical tamper to a minimum of 95 percent standard Proctor density. Field nuclear density testing shall be performed as detailed in Quality Control. CRBC shall conform to the specification for WSDOT 9-03.9 (3).

Measurement and Payment

Payment for Base Course shall be included in the unit price costs for CRBC and ACP or CRBC and PCCP. This payment will be full compensation for furnishing all labor, materials, and equipment required for Base Course.

7. Asphalt Concrete Pavement

General

Prior to starting work, Contractor shall provide permeability testing results performed on their proposed ACP or PCCP mix designs to ensure the hydraulic conductivity criteria of 1×10^{-5} cm/s as stated in the SOW is satisfied.

Specifications

The two requirements for the capping remedy stated in the SOW for asphalt concrete pavement (ACP) include:

- Thickness: 3 inches minimum
- Permeability: 1×10^{-5} cm/sec maximum

Mix Design Testing

Prior to start of work, Contractor shall submit an asphalt mix design with corroborating permeability testing results specific to Contractor's mix design materials of construction for verification mix will achieve SOW permeability requirements. Base course and mix design shall meet WSDOT specifications and EPA thickness and permeability requirements .

All materials, work, quality control, and quality standards for this specification shall be performed in accordance with and shall meet the requirements of the pertinent sections of the WSDOT Standard Specifications, current edition.

Mix, handle, batch, haul, place, roll and compact asphalt concrete in accordance with the applicable sections of the WSDOT Standard Specifications except that the thickness for base course shall be 4 inches and thickness for the ACP course shall be 3 inches. Placement shall be to dimensions and grades indicated on drawings or as directed by the Engineer.

Required tack coats shall be applied in accordance with applicable sections of WSDOT Standard Specifications.

All joints to existing asphalt shall be butt joints as per WSDOT Standard Specifications, use of other joint types must be approved by engineer.

Measurement and Payment

Payment for Asphalt Concrete Pavement shall be included in the unit price costs for CRBC and ACP. This payment will be full compensation for furnishing all labor, materials, and equipment required for Asphalt Concrete Pavement.

8. Portland Cement Concrete Pavement

General

Permeability specifications have been satisfied by reference. Contractor shall use Type II normal concrete with 14-day strength of 650 psi as provided in WSDOT Specification 5-05.3(1).

Specifications

The two requirements for the capping remedy stated in the SOW for asphalt concrete pavement (ACP) also apply to PCCP and include:

- Thickness: 3 inches minimum
- Permeability: 1×10^{-5} cm/sec maximum

Permeability of mature, good quality concrete is approximately 1×10^{-10} cm/sec (Portland Cement Association, Pub EB001). Based on this information no permeability testing for PCCP will be required prior to placement.

Construction of a PCCP cap will be performed in accordance with specifications for construction per WSDOT standard specifications thus yielding a concrete of good quality. All materials, work, quality control, and quality standards for this specification will be performed in accordance with and shall meet the requirements of the pertinent sections of the WSDOT Standard Specifications, current edition.

Placement will be to dimensions and grades indicated on drawings or as directed by the Oversight Engineer.

Measurement and Payment

Payment for Portland Cement Concrete Pavement shall be included in the unit price cost for CRBC and PCCP. This payment will be full compensation for furnishing all labor, materials, and equipment required for Portland Cement Concrete Pavement.

9. Railroad Construction

All railroad construction shall conform to the Burlington Northern Santa Fe Railway's *Design Guidelines for Industrial Track Projects*, (March 1, 1997), with the exception that all rail used for this project shall be 115-pound Number One relay rail.

10. Project Record and As-Built Documents

General

- A. Prior to starting work, the Contractor shall delineate one complete set of construction documents as the Job Set Record Documents for recording as-built conditions.
- B. Throughout progress of the Work of this Contract, the Contractor shall maintain an accurate record of all work completed, including changes in scope to the Contract Documents on the Job Set Record Documents.
- C. Making Entries on Drawings:
 - 1. Using an erasable red-colored pencil (not ink or indelible pencil), clearly describe any field change by note and by graphic line, as required. Date all entries.

2. Call attention to the entry by a bold "cloud" around the area(s) affected.
3. Note all change orders and contract change conditions.

D. Making Entries on Other Documents:

1. Where changes are caused by directives issued by Oversight Engineer, clearly indicate the change by note in ink, colored pencil, or rubber stamp.
2. Where changes are caused by Contractor-originated proposals approved by Oversight Engineer, including inadvertent errors by the Contractor that have been accepted by Oversight Engineer, clearly indicate the change by note in erasable red-colored ink.

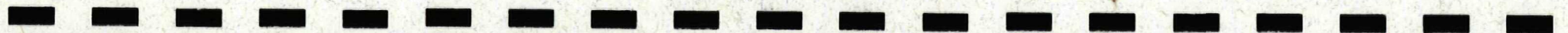
Final Record Documents

Immediately following completion of the Work of this Contract, the Contractor shall provide one complete and clearly marked set of Job Set Record Documents to the Oversight Engineer. All changes must be clearly marked in red and changes must be legible and understandable.

The Contractor shall participate in a review meeting or meetings as required by the Oversight Engineer and make all required changes and deliver within 10 working days to the Oversight Engineer.

Measurement and Payment

Project Record and As-Builts shall not be measured separately. It shall be considered incidental to, and included in the various lump sum and unit prices.





Appendix C

Construction Quality Control Plan

Construction Quality Control Plan for Design Set 1B

**Harbor Island Soil and Groundwater
Operable Unit Superfund Site
Seattle, Washington**

Prepared by:

**Remediation Technologies, Inc.
1011 S.W. Klickitat Way, Suite #207
Seattle, Washington 98134**

RETEC Project No.: 1-2900-850

Prepared for:

**Design Set 1B Participants
Harbor Island Soil and Groundwater Operable Unit
Seattle, Washington**

August 15, 1997

Construction Quality Control Plan for Design Set 1B

Harbor Island Soil and Groundwater Operable Unit Superfund Site Seattle, Washington

Prepared by:

**Remediation Technologies, Inc.
1011 S.W. Klickitat Way, Suite #207
Seattle, Washington 98134**

RETEC Project No.: 1-2900-850

Prepared for:

**Design Set 1B Participants
Harbor Island Soil and Groundwater Operable Unit
Seattle, Washington**

Prepared by:


Grant Hainsworth, P.E., Project Engineer

Technically Reviewed by:


Bryan W. Stone, P.E., Project Manager

August 15, 1997

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Figure 2-2	Design Set 1B Remedial Action Schedule, Harbor Island S&G OU	2-3

1 Introduction

This document presents the Construction Quality Control Plan (CQCP) and includes the requirements for the Construction Quality Assurance Project Plan (QAPP). Both the CQCP and the QAPP are required documents for the remedy to be implemented for Design Set 1B of the Soil and Groundwater Operable Unit (S&G OU) at the Harbor Island Superfund Site in Seattle, Washington. The soil remedy for Design Set 1B consists of capping areas on five properties exceeding relevant capping criteria. The purpose of this plan is to detail inspection and testing procedures to be employed during capping activities. The purpose of these procedures is to ensure that the completed work meets or exceeds all design criteria, contractual terms, and construction documents. The plan consists of the following elements:

- Project schedule
- Description of the responsibility and authority of involved personnel and organizations
- Statement of the professional qualifications of Construction Quality Assurance (CQA) personnel
- Description of testing and inspection activities to ensure performance criteria are satisfied
- Documentation procedures for all CQA activities
- Change order procedures
- Contingency procedures

2 Project Organization

2.1 Project Overview

All parties involved in the implementation of this project are identified in Figure 2-1. The S&G OU has a Steering Committee and Technical Subcommittee, representing the interests of the potentially responsible parties (PRPs). Each PRP is ultimately responsible for implementation of the remedy at their site. This CQCP has been prepared to address the Design Set 1B capping only sites which consist of Asahipen America, Inc, (Aspen Paints), Union Pacific Railroad Parcel A, Harbor Island Machine Works, Fisher Mills, Inc., and the Former Lone Star Northwest Property.

The S&G OU has retained Remediation Technologies, Inc. (RETEC) as their remedial design engineering consultant for the project. During capping activities, either RETEC or a PRP Consultant will have an Oversight Engineer present daily.

The S&G OU will retain a general contractor through a competitive bidding process to perform capping activities. The Oversight Engineer will ensure that the contractor complies with all the general requirements and performance standards. The general requirements and performance standards are detailed further in Section 3 and are also provided in the Design Report (RETEC, 1997).

2.2 Schedule and Milestones

Following EPA Approval of the Final (100%) design package, a contractor will be selected to perform the capping activities based on plans and specifications prepared by RETEC for the S&G OU. Upon completion of capping activities, the S&G OU will prepare and submit to EPA a completion report. The schedule summarizing these deliverables and activities is presented in Figure 2-2.

2.3 Responsibility and Authority

The contractor selected for capping activities will control the site, means of access and egress, at any time, will be provided by each property owner. Construction oversight and monitoring for overall compliance with this CQCP will be performed by RETEC or other PRP consultants. EPA will be responsible for reviewing and approving project deliverables. Project responsibility and authority are summarized in Table 2-1. The following is a discussion of the parties involved in the project and each party's responsibility and authority.

Figure 2-1 Project Organization, Design Set 1B

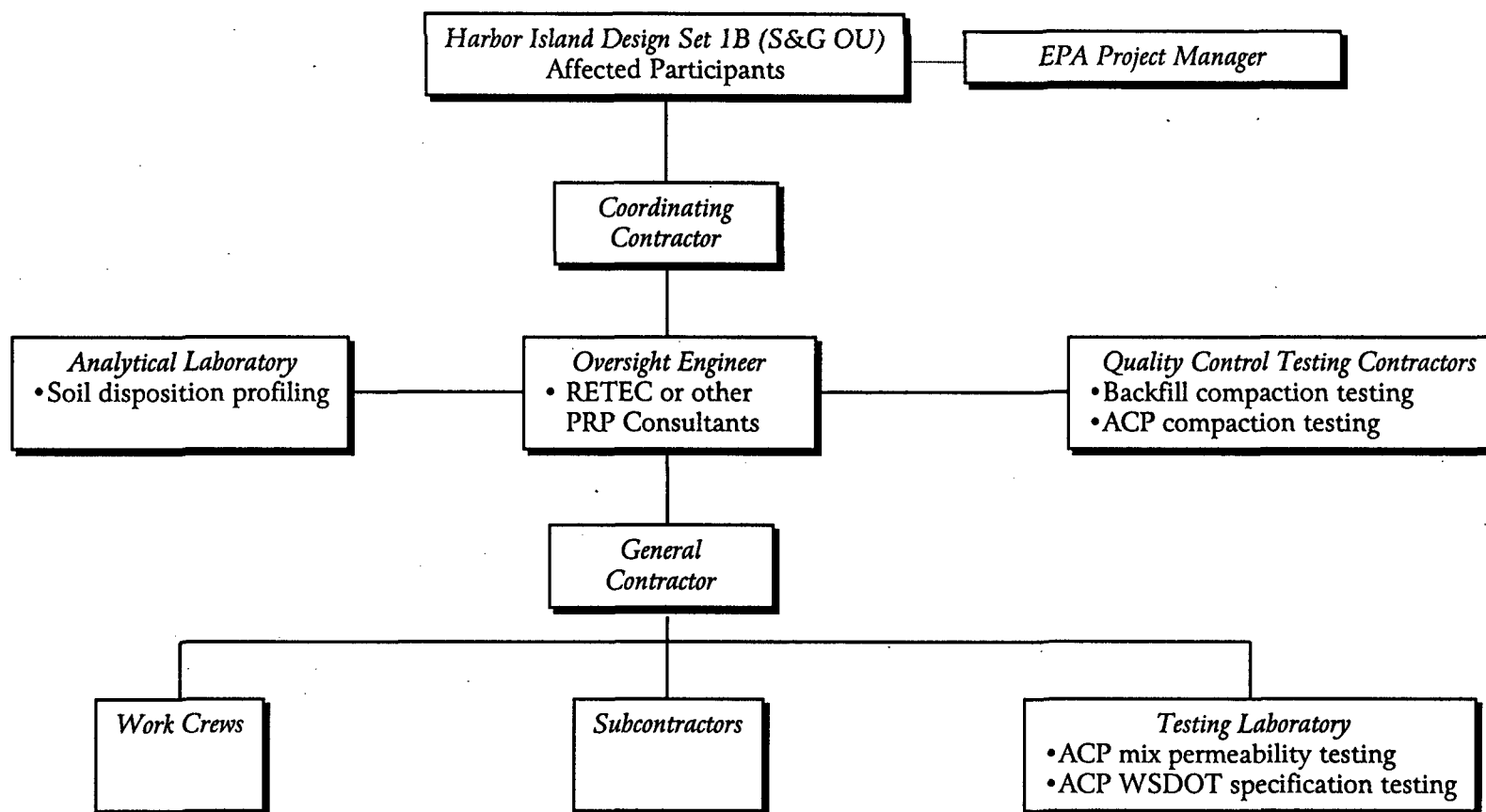
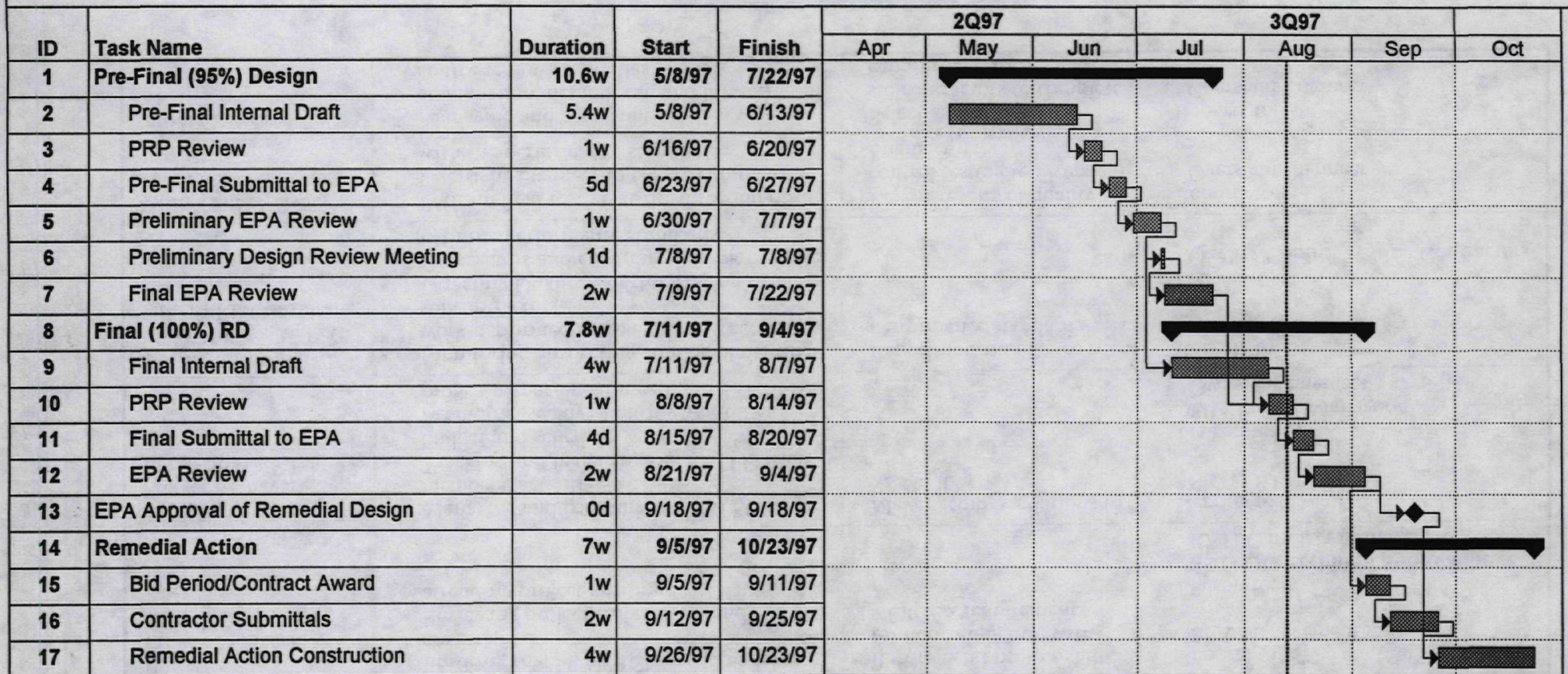


FIGURE 2-2
DESIGN SET 1B REMEDIAL ACTION SCHEDULE
HARBOR ISLAND S&G OU

4/25/97



Design schedule is based upon anticipated remedial action schedules that may change due to unforeseen delays related to weather, property acquisition, disruption to commercial activities, or other circumstances.

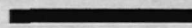
Task



Rolled Up Task



Progress



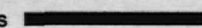
Rolled Up Milestone



Milestone



Rolled Up Progress



Summary



Table 2-1 Responsibility and Authority for Capping Activities

Position	Responsibility	Authority	
S&G OU Steering Committee	<ul style="list-style-type: none"> Managing the project's overall budget, schedule, and engineering design efforts related to the bid specifications and contracting 	<ul style="list-style-type: none"> Negotiate and authorize change orders or scope changes 	Reports to: S&G OU PRPs
Technical Subcommittee	<ul style="list-style-type: none"> Managing and coordinating technical aspects of the project relating to environmental issues Facilitating and leading regulatory interaction 	<ul style="list-style-type: none"> Approve shutdown of the general contractor or any subcontractor Dismiss the general contractor or any subcontractor 	Liaison to: EPA Project Manager RETEC Project Manager
EPA Project Manager: Keith Rose	<ul style="list-style-type: none"> Ensuring that all CERCLA requirements are satisfied Reviewing project deliverables and attending project meetings 	<ul style="list-style-type: none"> Recommend project shutdown for noncompliance with CERCLA requirements 	Reports to: EPA Management Liaison to: S&G OU Technical Subcommittee RETEC Project Manager
RETEC Project Manager: Bryan Stone, P.E.	<ul style="list-style-type: none"> Managing and coordinating RETEC team members' activities Tracking and managing the RETEC team budget and schedule Attending weekly, monthly and other project management meetings 	<ul style="list-style-type: none"> Make recommendations to S&G OU 	Reports to: S&G OU Liaison to: EPA Project Manager Oversight Engineer
Oversight Engineer Jestin Hurst - RETEC Other PRP Consultants	<ul style="list-style-type: none"> Monitoring, inspecting, and documenting work performed by general contractor and subcontractors Directing Quality Control Testing Contractors and ensuring all work complies with the performance standards 	<ul style="list-style-type: none"> Report noncompliance with performance standards 	Reports to: RETEC Project Manager Liaison to: Quality Control Testing Contractors
Quality Control Testing Contractors	<ul style="list-style-type: none"> Perform field testing at the direction of the Oversight Engineer to ensure compliance with the performance standards 	<ul style="list-style-type: none"> Report results of quality control testing to Oversight Engineer 	Reports to: Oversight Engineer
General Contractor	<ul style="list-style-type: none"> Managing and coordinating all stabilization, demolition, and limited source removal activities 	<ul style="list-style-type: none"> Select and utilize subcontractors to complete capping activities 	Reports to: Oversight Engineer

2.3.1 S&G OU Representative

The S&G OU Steering Committee represents the owners who are responsible for implementing the Record of Decision (ROD) (EPA, 1996). The Remedial Design Work Plan (RDWP) (RETEC, 1997) outlined Design Set 1B capping as one of the activities required at the S&G OU. The Design Set 1B Participants have selected an S&G OU Representative who will document to the EPA that Design Set 1B capping activities were performed in a manner that met or exceeded the contractual terms and performance criteria. The S&G OU 1B Representative will be responsible for the project schedule, budget, and satisfactory completion of all capping activities.

2.3.2 U.S. Environmental Protection Agency (EPA)

Under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), EPA will review capping activities. EPA has the authority to review any revisions or requests for changes that are submitted during the course of the work. EPA may also review quality control records during or after capping activities to confirm that the work was completed in a manner that met or exceeded, with a reasonable degree of certainty, all performance criteria outlined in this plan. The EPA may also review the Contractor Health and Safety Plan.

2.3.3 Remediation Technologies, Inc. (RETEC)

RETEC is an environmental consulting and engineering company retained by the S&G OU to design and oversee capping. RETEC will provide an oversight engineer responsible for monitoring daily activities and for ensuring that the general contractor is meeting performance standards. The Oversight Engineer will maintain a file of all samples and observations and will log all off-site shipments of materials.

2.3.4 Other PRP Consultants

PRPs involved in the Design Set 1B capping activities may choose to have their own consultants act as Oversight Engineer. These consultants will act in the same role as noted above for RETEC on a site-specific basis.

2.3.5 Quality Assurance Testing Contractors

The Oversight Engineer will use Quality Assurance Testing Contractors to periodically inspect certain aspects of capping activities to ensure they meet requirements and are placed in conformance with the design criteria, contractual terms, and construction documents. Based on the results of their inspections and tests, materials for construction will be approved or rejected. Tests performed

during the course of construction will form the basis of determining if the contractor's construction procedures are adequate or if they must be modified to achieve design requirements. Quality Assurance Testing Contractors will likely include an analytical laboratory for soil disposition profiling and a geotechnical testing firm for base course and asphalt concrete pavement compaction testing.

2.3.6 General Contractor (Contractor)

The contractor for the S&G OU will report to the RETEC Oversight Engineer. The superintendent for the contractor will be responsible for managing and coordinating all field activities, including subcontractors, to the satisfaction of the S&G OU, EPA, and RETEC. The contractor will also hire a materials testing laboratory to perform the initial mix design asphalt concrete pavement (ACP) and Portland cement concrete pavement (PCCP) testing to ensure compliance with the performance criteria.

2.4 Construction Quality Assurance (CQA) Personnel

The overall responsibility of CQA personnel are to perform those activities specified in this plan. CQA personnel will include a designated CQA Oversight Engineer, specialized inspection staff and trained testing technicians.

2.4.1 CQA (Oversight) Engineer

The specific responsibilities of the Oversight Engineer include:

- Serving as liaison with the subcontractors in interpreting and clarifying project construction documents
- Educating construction personnel on job requirements and interacting with the subcontractors to provide assistance, as needed, in modifying the materials and work to comply with the specified design
- Performing site inspections, scheduling inspections of specific aspects of construction by specialized personnel, and testing of construction materials by the Quality Assurance Testing Contractor
- Providing EPA and the subcontractors with reports on inspection results, findings and recommendations

2.4.2 Specialized Inspection Personnel

Inspections will be required that must be performed by personnel with specialized expertise in various aspects of the project. These personnel include individuals

experienced in soil and asphalt compaction testing. These individuals will inspect those aspects of the project when requested by the Oversight Engineer, assist subcontractors in achieving design requirements and prepare reports of these inspections for the Oversight Engineer.

2.4.3 Testing Technicians

Testing technicians will be provided by the Quality Assurance Testing Contractor under the direction of the Oversight Engineer to perform tests on the construction materials to ensure that they meet the design requirements. These individuals will assist subcontractors in determining construction procedures required to place materials in accordance with the contract documents.

2.5 Project Communication

The project organization chart is located in Figure 2-1. Lines of communication to be utilized throughout capping activities are indicated.

2.6 Project Meetings

Periodic meetings will be held to ensure that all personnel are familiar with capping procedures and any design changes. The first meeting will be a preconstruction meeting to be held at the site. Participants at this meeting will include representatives of EPA, the RETEC Project Manager and Oversight Engineer, and the Superintendents for all subcontractors. The agenda of this meeting will include:

- Responsibilities of each organization and the lines of authority and communications
- Established protocols for observations, testing and for handling construction deficiencies, repairs and retesting
- Methods for documenting, reporting, distributing and storing inspection data
- Work area security and safety protocols
- A site walk to verify that all contract terms, design criteria and construction documents are understood and to review existing site conditions, materials stockpile and equipment storage locations

Additional progress meetings will be held daily during construction activities. These meetings will be held by the Oversight Engineer, the contractor and any other individuals with responsibility for one or more aspect of the project which is currently under way or whose presence is requested by the Oversight Engineer. The purpose of these meetings will be to review the previous days activities, discuss the activities planned for the current day and discuss any potential problems. Special meetings may also be held if a problem or deficiency is present or is likely to occur so that the problem can be defined and resolved. All meetings will be documented by the Oversight Engineer in daily field notes.

3 Inspection and Testing

The Oversight Engineer will prepare weekly quality assurance reports that identify the prime and subcontractor personnel and equipment on site, idle equipment and personnel, material deliveries, weather conditions, work accomplished, inspections and tests conducted, results of inspections and tests, nature of defects found, reasons for rejection, and corrective actions taken.

This section describes the observations and tests that will be performed throughout the capping activities to ensure that the work is conducted in accordance with the contract documents.

3.1 Preconstruction Testing

Prior to the start of construction, the Contractor shall provide the Oversight Engineer with sieve analysis and standard Proctor density testing data for each source of crushed rock base course (CRBC) material to be used. All samples will be handled and analyzed in accordance with appropriate ASTM standards. The Contractor shall also provide falling head permeability testing data for the selected ACP and PCCP to ensure performance criteria are satisfied. All tests will be performed in accordance with appropriate ASTM procedures. Refer to Table 3-1 for preconstruction testing procedures and frequencies.

3.2 Construction Testing and Inspections

Full-time inspection of all construction operations will be performed during construction by the Oversight Engineer. In order to stay current with construction progress, the Project Manager and the Oversight Engineer will be in daily contact.

Inspections of specific aspects of the activities will be performed from time to time by various individuals with specialized expertise in specific aspects of the project. The independent Quality Assurance Testing Contractor will perform periodic field compaction testing at the direction of the Oversight Engineer.

Table 3-1 Performance Standards

Standard	Parameter	Level of Performance	Testing Method or Specification	Frequency of Testing	Comments
<i>Preconstruction Testing</i>					
Base Course	Gradation	WSDOT crushed surfacing base course	WSDOT 9-03.9(3)	For each source	
	Los Angeles wear, 500 rev Degradation factor, base course	35% maximum 15% minimum	WSDOT Method 131 WSDOT Method 113	For each source For each source	
	Compaction	Max. standard density	WSDOT Method 606	For each source	
ACP Cap	Gradation	WSDOT Class B	WSDOT 9-03.8(6)	For each source	
	Los Angeles wear, 500 rev Degradation factor, wearing course	30% maximum 30% minimum	WSDOT Method 131 WSDOT Method 113	For each source For each source	
	Cohesion value Modified Lottman Stripping Test	100 minimum PASS	WSDOT Method 719 Modified Lottman	For each source For each source	
	Asphalt content (AR 4000)	4.0–7.5%	WSDOT Method 718	For each source	
	Stabilometer value	35 minimum	WSDOT Method 722	For each source	
	Percent voids	2.0–4.5	ASTM D3637	For each source	
	Permeability (non-destructive) Maximum standard density	1×10^{-5} cm/s max. Rice density	ASTM D2726 WSDOT Method 705	For each source For each source	
PCCP Cap	Materials	WSDOT Class B	WSDOT 5-05.3(1)	For each source	

Table 3-1 Performance Standards continued

Standard	Parameter	Level of Performance	Testing Method or Specification	Frequency of Testing	Comments
<i>Construction Testing</i>					
Subgrade Preparation	Compaction in fill areas	95 percent Standard Proctor Density	WSDOT Method 613	Once per capping area per lift	Any layer of subgrade fill material shall not exceed 8 inches in depth without compaction; subgrade fill only anticipated at Fisher Mills
	Compaction in cut areas	To satisfaction of Oversight Engineer	None	None	Compaction in cut areas shall consist of a minimum of 2 passes over area with a vibratory roller
Base Course	Compaction	95 percent standard density	WSDOT Method 613	Once per capping area or every 100 square yards, whichever is smaller	Any layer of base course material shall not exceed 4 inches in depth without compaction
ACP Cap	Density	91 percent Rice density or greater as determined during mix design	WSDOT Method 613	Once per capping area or every 100 square yards, whichever is smaller	Contractor to submit optimum densities for each mix design to be used by Field Inspectors for compliance
Emission Controls	Dust	Section 9.15, PSAPCA Regulation I	Visual	Continuous	Contractor shall provide dust suppression measures
Noise Control	Exceedance of maximum permissible sound levels	RCW 70.107 SMC Title 25.800	None	None	Work shall only occur during daylight hours; sites are in industrial areas with no domestic dwellings nearby

Table 3-1 Performance Standards continued

Standard	Parameter	Level of Performance	Testing Method or Specification	Frequency of Testing	Comments
Criteria for Off-site Shipment	Stockpiled soil	Subtitle D waste Subtitle C waste Remain on site	Analytical results <DW criteria Analytical results >DW criteria None	Once every 200 cubic yards; a minimum of once per property	Soil remaining on site may be used as fill material and capped in accordance with EPA capping requirements or stored until such time
	Asphalt debris	Subtitle D waste Recycling facility	Analytical results >DW criteria Analytical results <DW criteria	Once every 200 cubic yards; a minimum of once per property	Asphalt will not be tested for TCLP metals if capping is required for previous detection of organic constituents only
	Concrete debris	Subtitle C waste Recycling facility	Analytical results >DW criteria Analytical results <DW criteria	Once every 200 cubic yards; a minimum of once per property	Concrete will not be tested for TCLP metals if capping is required for previous detection of organic constituents only
	Vegetation	Subtitle D waste	None	None	Vegetation cleared from site during clearing and grubbing shall be sent to receiving facility with soil sent off site
	Decontamination water	Receiving facility requirements	TPH by EPA 418.1 PAH by EPA 8270 Metals by EPA 6010	Once per container	Decontamination water shall be sent to an EPA-approved TSD facility. Testing will only be done for those constituents previously detected in the soil.

NOTES:

max. - maximum

DW criteria - Dangerous Waste criteria taken from MTCA 173-303

Analytical Results from samples taken from stockpiled soil, asphalt, or concrete debris. Samples will only be analyzed for those constituents previously found at levels greater than capping criteria.

3.2.1 Subgrade Preparation

The Contractor will remove and place common borrow within the work area to provide the grades shown on the construction drawings. The subgrade in "cut" areas will then be prepared by compacting any loose soil with two passes of a mechanical tamping device. Subgrade soil in fill areas, or where the Contractor has over-excavated by more than 4 inches, will be placed in maximum 8-inch loose lifts then compacted to 95 percent Standard Proctor Density.

Visual inspections and documentation of these operations will be performed by the Oversight Engineer. Upon completion of the preparation of the subgrade, the Oversight Engineer will visually inspect grades to ensure that the subgrade is placed as specified in the construction documents.

3.2.2 Base Course and Asphalt Placement and Compaction

The base course will be placed by the Contractor in a single 4-inch lift. The base course will be compacted by at least 10 passes of a mechanical hand tamper or small vibratory roller to a final density of 95 percent of the Standard Proctor Density.

ACP will be placed in a single 3-inch lift by the Contractor. The ACP will be compacted with a non-vibratory roller to a minimum final density that will be determined during mix design testing.

Compaction operations will be inspected by full-time visual observation and density compaction testing. If test results indicate that the material is inadequately compacted, the Contractor will be directed to rework the lift until subsequent tests meet specifications.

4 Documentation

Documentation of CQA activities will ensure that the inspections have been made and that any required corrective action has been completed.

4.1 Daily Record Keeping

The Oversight Engineer will be responsible for maintaining daily records of the capping activities. These records will include a summary report with supporting inspection data sheets and, as necessary, problem identification and corrective measure reports. Daily record keeping will also document field health and safety monitoring and a log of off-site shipments.

4.2 Quality Assurance Testing Contractors Forms

The Quality Assurance Testing Contractor will provide documentation of all testing activities. On-site testing will be documented in test report forms which detail the location of all tests taken, the test results, and relevant notes or remarks including discussions with the contractor. The test measurements shall reference the construction activities and the location on the site. Preliminary copies of these reports will be provided to the Oversight Engineer at the end of each day. These reports will be finalized after technical review by the testing technician's supervisor, at which time final copies will be submitted to the Oversight Engineer.

Laboratory tests of construction materials will be documented on the testing contractors test report forms. Preliminary results may be transmitted in the form of copies of handwritten data sheets and calculations. Final results will be transmitted after internal technical review by the Quality Assurance Testing Contractor.

4.3 Completion Report

All reports described above will be reviewed by the Oversight Engineer and will be submitted on a weekly basis to the Project Manager. The Oversight Engineer will review these reports, analyze the data and summarize the information into a Completion Report. The intent of this report is to demonstrate that construction was satisfactorily completed in accordance with the design documents.

The Completion Report, including all daily inspection summary reports, inspection data sheets, problem identification and corrective measures reports, laboratory test results, a description of any deviations from the design and

materials specifications (with justifying documentation), and as-built drawings will be submitted to EPA after completion of the all capping activities. This document will be certified correct by the Project Manager and the Oversight Engineer.

5 Change Order Procedures

The Oversight Engineer will advise of minor changes not involving an adjustment to contract price or contract time as authorized by the written agreement by supplemental written instructions.

The Oversight Engineer may issue a Notice of Change which includes; a detailed description of a proposed change with supplementary or revised drawings and specifications, a change in contract time for executing the change with a stipulation of any overtime work required, and the period of time during which the requested price will be considered valid. The contractor will prepare and submit an estimate within 2 days.

The contractor may propose a change by submitting a request for change to the Oversight Engineer, describing the reason for the change, and the effect on the contract price and contract time. Full documentation and a statement describing the effect on work by separate or other contractors shall be included.

6 Emergency Procedures

The Health and Safety Program has been established to allow the work to be conducted without adverse impacts on worker health and safety. In addition, supplementary emergency response procedures have been developed to cover extraordinary conditions at the site.

6.1 General

The Contractor shall provide an on-site individual trained in first aid and CPR when work is in progress. A map of the direct route to the nearest hospital shall be available on site and local ambulance service available. A list of emergency phone numbers and contacts shall also be available on site.

All accidents and unusual events will be dealt with in a manner to minimize a continued health risk to site workers. In the event that an accident or other unusual event occurs, the following procedures will be followed:

- First aid or other appropriate initial action will be administered by those closest to the accident/event. This assistance will be conducted so that those rendering assistance are not placed in a situation of unacceptable risk.
- All accidents/unusual events must be reported to the Oversight Engineer who is responsible for conducting the emergency response in an efficient, rapid, safe manner. The Oversight Engineer or designated assistant will decide if off-site assistance and/or medical treatment is required and arrange for assistance.
- All workers on site should conduct themselves in a mature, calm manner in the event of an accident or unusual event. All personnel must take precautions to avoid spreading the danger to themselves and surrounding personnel.

The following is a list of emergency equipment that the Contractor will have available on site:

- Adequately stocked first aid kit
- Emergency eye wash
- Fire extinguisher
- Blankets

6.2 Responses to Specific Situations

The following emergency procedures will be used by on-site personnel in the event of an emergency situation. The Oversight Engineer shall be notified of any on-site emergencies and be responsible for ensuring that the appropriate procedures are followed.

6.2.1 Personal Injury in the Contamination Area

The injured person will be removed from the danger area at which time 911 will be notified. The injured person will be decontaminated, if possible, and appropriate first aid shall be initiated. The Oversight Engineer will then notify the project manager and apprise them of the situation. No persons shall reenter the contamination area until the cause of the injury or symptoms is determined.

6.2.2 Fire/Explosion

All site personnel shall be notified and moved in an orderly fashion to a prearranged location. The Oversight Engineer will notify the fire department and other local agencies as required.

6.2.3 Personal Protective Equipment Failure

If any site worker experiences a failure of protection equipment that affects the protection factor, that person and his/her buddy shall immediately leave the contamination area. Reentry shall not be permitted until the equipment has been repaired or replaced.

6.2.4 Other Equipment Failure

If any other equipment on site fails to operate correctly, the Oversight Engineer shall be notified and determine the effect of the failure on continuing operations at the site. If the failure affects the safety of personnel or prevents completion of the work, all personnel shall leave the site until the situation evaluated and appropriate actions taken.

If the injury to the worker caused by any of the aforementioned reasons is chemical in nature (e.g., overexposure), the following immediate first aid procedures are to be initiated:

- **Eye Exposure.** If contaminated solids or liquids get into the eyes, wash eyes immediately at the emergency eye wash station using large amounts of water and lifting the lower and upper lids occasionally. Obtain medical attention immediately.

- **Breathing.** If a person inhales large amounts of a toxic vapor, move the exposed person to fresh area immediately. If breathing has stopped perform CPR. Keep the affected person warm and at rest and obtain medical attention as soon as possible.
- **Swallowing.** When contaminated solids or liquids have been swallowed, the Poison Control Center will be contacted and their recommended procedures followed.

Fire extinguishers shall be available on site. If a localized fire breaks out, chemical fire extinguishers will be used. If necessary and feasible, a fire blanket, soil, or other inert materials will be placed on the burning area to extinguish the flames and minimize the potential for spreading. Water or foam should not be used. If required, local fire-fighting authorities will be notified.

In all situations, when an on-site emergency results in evacuation of the contamination area, personnel shall not reenter until:

- The conditions resulting in the emergency have been corrected
- The hazards have been reassessed
- The Site Health and Safety Plan has been reviewed
- Site personnel have been briefed on any changes in the Site Health and Safety Plan

In the event the air temperature during the construction operations exceeds 90°F, heat stress monitoring will be initiated. Dependant on meteorological conditions and general overall health of individuals, heat stress can occur rapidly sometimes within 10 to 15 minutes. The various types of heat problems and their associated symptoms are as follows:

- **Heat Exhaustion.** Caused by profuse perspiration. Signs are pale, clammy skin, tiredness or weakness, headache or nausea, with normal body temperature.
- **Heat Stroke.** Caused by physical activity in hot climates. Signs are red or flushed skin, hot, dry skin, high body temperature, dizziness, nausea, headache, rapid pulse and unconsciousness.

- **Heat Rash.** Caused by continuous exposure to heat and humid air and aggravated by chafing clothes. Decreases ability to tolerate heat.
- **Heat Cramps.** Caused by profuse perspiration with inadequate fluid and chemical replacement (salts). Signs are muscle spasms and pain in extremities and abdomen.



7. CORRELATION OF NUCLEAR GAUGE DETERMINED DENSITIES WITH ASPHALT CONCRETE PAVEMENT CORES

- a. Density determination for density acceptance on asphalt concrete pavement shall be made in the direct transmission mode whenever possible.
- b. Gauge-core correlation shall be required for statistical evaluation of degree of asphalt compaction.
 - (1) For each combination of gauge and job mix formula.
 - (2) For direct transmission and for back scatter modes (when used).
 - (3) For a change in direct transmission probe depth.
- c. A new gauge-core correlation is not required.
 - (1) For different contracts if JMF and gauge are the same.
 - (2) For a change in bases (i.e., surfacing to overlay).
- d. Gauge correlation is based on 10 density determinations and 10 cores taken at corresponding locations. Gauge densities shall be determined on the day of paving. Cores shall be taken no later than the day following paving.
- e. Core densities shall be determined in conformance with WSDOT Test Method 704: Method of Test for Specific Gravity and Weight per Cubic Foot of compacted Asphalt Mixtures.
- f. Correlation factor shall be determined in accordance with Standard Form 350-112: Correlation Nuclear Gauge to Core Density.

10:P:DP/MM

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Appendix D

Washington State Department of Transportation Specifications

4-04 BALLAST AND CRUSHED SURFACING**4-04.1 Description**

This work shall consist of constructing one or more courses of crushed stone upon a prepared subgrade in accordance with these Specifications in conformity with the lines, grades, depth, and typical cross-sections shown in the Plans or as established by the Engineer.

Surfacing materials and ballast may also be specified to be placed in stockpiles for future use.

4-04.2 Materials

Materials shall meet the requirements of the following sections:

Ballast	9-03.9(1)
Shoulder Ballast	9-03.9(2)
Crushed Surfacing	9-03.9(3)
Maintenance Rock	9-03.9(4)

4-04.3 Construction Requirements**4-04.3(1) Equipment**

All equipment necessary for the satisfactory performance of this construction shall be on the project and approved by the Engineer prior to beginning work. If central mix plant methods are used, the central mixing plant shall comply with the following requirements:

The cold aggregate feeder shall be mechanically operated and adjustable to the extent necessary to provide a uniform and continuous flow of materials. These materials shall be deposited in an approved mixer with a sufficient amount of water being added to obtain the required density when spread and compacted. The water shall be weighed or metered, and dispensed through a device providing uniform dispersion across the mixer.

The mixing plant shall be provided with weighing or calibrating devices, feeders, provisions for sampling, and other devices and equipment so designed, coordinated, and operated to produce a uniform mixture, and to permit the sampling of the materials before and after mixing. The mixer shall be kept in good condition, and mixing blades or paddles shall be of proper size, adjustment, and clearance to provide positive and uniform mixing of the mixture at all times.

The capacity of the plant and equipment furnished on the work shall be adequate at all times to provide for efficient and continuous operations insofar as practical.

4-04.3(2) Subgrade

The subgrade shall be prepared as specified in Section 2-06 and shall be approved by the Engineer before placing ballast or surfacing materials.

4-04.3(3) Mixing

Unless otherwise specified, the Contractor may use either, or both, of the following described methods:

1. Central Plant Mix Method. The surfacing material and water shall be mixed in an approved mixing plant as described in Section 4-04.3(1). The completed mixture shall be a thoroughly mixed combination of proportioned materials and water, uniform in distribution of particle sizes and moisture content. A mixture containing water in excess of the proportion established by the Engineer will not be accepted.
2. Road Mix Method. After material for each layer of surfacing has been placed, the material shall be mixed until uniform throughout by motor graders or other equipment approved by the Engineer. Water to facilitate mixing and compacting shall be added in amounts approved by the Engineer.

4-04.3(4) Placing and Spreading

1. Central Plant Mix Method. After mixing, material for each layer of surfacing shall be transported to the roadway in approved vehicles. Vehicles for hauling the mixture shall be capable of depositing the mixture within the receiving hopper of the spreading equipment, or in windrows of uniform size in front of the spreading equipment, with a minimum of segregation of the mix. A motor grader may be used as the spreading machine or the spreading machine shall be capable of receiving the material by direct deposit in its hopper from the hauling vehicle or from a uniform windrow, and be capable of spreading and screeding the material to a depth and surface that when compacted will be true to line, grade, depth of course, and cross-section without further shaping.
2. Road Mix Method. Each layer of surfacing material shall be spread by equipment that is approved by the Engineer. Equipment that causes segregation of the surfacing material during the spreading operation will not be allowed. Similar types of spreading equipment shall be used throughout the limits of each separate spreading operation. Spreading on small areas of less than 2,000 square yards or on areas irregular in shape, may be accomplished by other means as approved by the Engineer.

The following nominal depth of compacted material shall not be exceeded in any one course without the approval of the Engineer:

Ballast	0.50 foot
Gravel Base	0.75 foot
Crushed Surfacing	0.35 foot

4-04.3(5) Shaping and Compaction

Immediately following spreading and final shaping, each layer of surfacing shall be compacted to at least 95 percent of the standard density determined by WSDOT test method No. 606 before the next succeeding layer of surfacing or pavement is placed. The determination of field in-place density shall be made by the Nuclear gauge or the Washington Densometer. When the thickness of surfacing is less than 0.15 foot, density testing will not be required and the Engineer will determine the number of coverages required for the particular compaction equipment available.

Vibratory compactors and rollers shall obtain the specified density for each layer. A mist spray of water shall be applied as needed to replace moisture lost by evaporation. The completed layer shall have a smooth, tight, uniform surface true to the line, grade, and cross-section shown in the plans, or as staked by the Engineer.

4-04.3(6) Keystone

When necessary, as determined by the Engineer, crushed surfacing top course shall be used for keystone to key the top surface of ballast, gravel base, crushed surfacing base course, or any other surfacing course which requires keying. The keystone shall be spread evenly on top of the surfacing course by means of approved spreading equipment. The surface shall be watered and, if necessary, bladed lightly until the keystone is worked into the interstices of the surfacing course without excessive displacement and shall be compacted. The operations of adding keystone, wetting, blading, and compacting shall be continued until the course has become thoroughly keyed and compacted.

When keystone is required, that is subject to public traffic, it shall be placed before terminating each day's operation.

Keystone placed for the convenience of the Contractor, with approval of the Engineer, for the purpose of creating a more dense surface on which to pave will be allowed within the top 0.20 foot of crushed surfacing base course, gravel base, or ballast. Keystone placed for this purpose will be paid for at the lower unit contract price for either the base material being keyed or crushed surfacing top course.

4-04.3(7) Miscellaneous Requirements

The surface of each layer of surfacing material shall be maintained true to line, grade, and cross-section by blading, watering, and rolling until placing the next succeeding course. The first course of surfacing material shall be placed on all available subgrade before placing the succeeding course unless otherwise authorized by the Engineer. Unless otherwise approved, there shall be a distance of not less than one station between the construction of any two courses of surfacing or ballast.

Should irregularities develop in any surface during or after compaction, they shall be remedied by loosening the surface and correcting the defects after which the entire area including the surrounding surface shall be thoroughly recompact. Any additional materials necessary to make the repairs shall be furnished by the Contractor at the unit contract price.

4-04.3(8) Weather Limitations

When, in the opinion of the Engineer, the weather is such that satisfactory results cannot be obtained, the Contractor shall suspend operations until the weather is favorable. No surfacing materials shall be placed in snow or on a soft, muddy, or frozen subgrade.

4-04.3(9) Hauling

Hauling equipment shall be routed over the roadway in a manner to be most effective in the compacting of the surfacing. Hauling over any of the surfacing in the process of construction will not be permitted when, in the opinion of the Engineer, the effect will be detrimental. All loads shall be of uniform capacity unless deviation is expressly authorized by the Engineer.

4-04.3(10) Hours of Work

The Contractor shall arrange surfacing operations so that the placing of materials will be accomplished during daylight hours. However, when necessary to complete the project within the time specified, or to avoid peak periods of public traffic, work may be undertaken during the hours of darkness, provided the Contractor furnishes and operates adequate lighting. Inability to demonstrate reliable and satisfactory results will be reason

to order termination of night operations, and the Contractor shall procure additional equipment and personnel necessary to satisfactorily complete the work as specified while operating during daylight hours only.

4-04.3(11) Shoulder Ballast

Shoulder ballast shall not be placed until the abutting pavement has been completed unless designated by the Engineer. Shoulder ballast shall be placed through a spreader box in one lift. Processing of the shoulder ballast course on the roadway will not be permitted. Compaction shall be accomplished by making a minimum of three passes over the aggregate with a vibratory compactor of a type acceptable to the Engineer. The density requirements of Section 4-04.3(5) shall not apply.

4-04.4 Measurement

Crushed surfacing top course, base course, ballast, and gravel base, when mixed at a central plant, will be measured by the ton. The weight of water added at the plant will be deducted on a daily basis from the total tonnage of aggregates, including water, placed that day which were processed through the central plant and placed on the roadway. The resultant tonnage of surfacing materials will be paid for at the unit contract price. The weight of deducted water will be converted to gallons and will be paid for at the unit contract price for water.

Crushed surfacing top course, base course, ballast, and gravel base, when mixed by the road mix method, will be measured by the ton or by the cubic yard. If measured by the cubic yard, measurement will be made in the hauling conveyance at the point of delivery on the roadway.

Shoulder ballast and crushed surfacing top course used as keystone will be measured by the ton or by the cubic yard.

Crushed surfacing materials for placement in stockpile will be measured by the ton or cubic yard. If measured by the cubic yard, the volume will be determined by cross-sectioning the stockpile.

Maintenance rock will be measured in the same manner prescribed for crushed surfacing materials.

Water used in placing and compacting surfacing materials on the roadway will be measured in accordance with Section 2-07.

4-04.5 Payment

Payment will be made in accordance with Section 1-04.1, for each of the following bid items that are included in the proposal:

"Crushed Surfacing Top Course (or Base Course)", per ton, or per cubic yard.

"Crushed Surfacing Top Course (or Base Course) in Stockpile", per ton, or per cubic yard.

"Crushed Surfacing Top Course (or Base Course) from Stockpile", per ton, or per cubic yard.

"Ballast", per ton, or per cubic yard.

"Ballast in Stockpile", per ton, or per cubic yard.

"Ballast from Stockpile", per ton, or per cubic yard.

"Shoulder Ballast", per ton, or per cubic yard.

"Shoulder Ballast in Stockpile", per ton or per cubic yard.

"Shoulder Ballast from Stockpile", per ton or per cubic yard.

"Maintenance 1/2 In. Minus in Stockpile", per ton, or per cubic yard.

4-06 ASPHALT TREATED BASE**4-06.1 Description**

Asphalt treated base consists of a compacted course of base material which has been weatherproofed and stabilized by treatment with an asphalt binder.

The work shall consist of one or more courses of asphalt treated base placed on the subgrade in accordance with these Specifications and in conformity with the lines, grades, thicknesses, and typical cross-sections shown in the Plans or staked by the Engineer.

4-06.2 Materials

Materials shall meet the requirements of the following sections:

Asphalt	9-02.1
Anti-Stripping Additive	9-02.4
Aggregates	9-03.6

The grade of paving asphalt shall be AR-4000W meeting the requirements of Section 9-02.1(4).

4-06.3 Construction Requirements**4-06.3(1) Asphalt Mixing Plant**

Asphalt mixing plants for asphalt treated base shall meet the following requirements:

Heating

The plant shall be capable of heating the aggregates to the required temperature.

Proportioning

The mixing plant shall be capable of proportioning: the aggregates to meet the specifications; and the asphalt at the rate specified by the Engineer. If the aggregates are supplied in two or more sizes, means shall be provided for proportioning or blending the different sizes of aggregates to produce material meeting the specification requirements.

Mixing

The mixer shall be capable of producing a uniform mixture of uniformly coated aggregates meeting the requirements of these Specifications.

4-06.3(2) Preparation of Aggregates

Aggregates for asphalt treated base shall be stockpiled before use in accordance with the requirements of Section 3-02.

The aggregates shall be heated as required by the Engineer.

4-06.3(2)A Mix Design

The mix design requirements for asphalt treated base shall be as described in Section 5-04.3(7)A.

4-06.3(3) Heating of Asphalt Material

Heating of the asphalt material shall conform to the requirements of Section 5-04.3(6).

5-02 BITUMINOUS SURFACE TREATMENT**5-02.1 Description**

This work shall consist of constructing a single or multiple course bituminous surface treatment in accordance with these Specifications and in conformity with the lines and cross-sections shown in the Plans or as designated by the Engineer. During bituminous surface treatment paving operations, temporary raised pavement markings shall be maintained throughout the project. Temporary raised pavement markings shall be installed on the roadway that was paved that day. Temporary raised pavement markings shall be in accordance with Section 8-23.

5-02.1(1) Bituminous Surface Treatment Class A

This method of treatment requires two applications of asphalt and three applications of aggregate as specified. The second application (tack coat) shall be applied not less than ten days after the first application (prime coat) for cutback asphalts and as approved by the Engineer for emulsified asphalts.

5-02.1(2) Bituminous Surface Treatment Classes B, C, and D

These methods require the placing of one application of asphalt and one or more sizes of aggregate as specified to an existing asphalt roadway to seal and rejuvenate the surface and to produce a uniform roadway surface with good nonskid characteristics.

5-02.2 Materials

Materials shall meet the requirements of the following sections:

Asphalt (grade specified)	9-02
Anti-Stripping Additive	9-02.4
Aggregates	9-03.4

Aggregate to be used for bituminous surface treatment shall be of the type and size called for in the Plans or in the proposal.

The particular asphalt to be used on any project shall be that which is called for in the Special Provisions, the proposal, or shown in the Plans, and may be conditionally accepted at the source.

When cutback asphalts are specified or ordered by the Engineer for BST Class A, or for BST Class C used in conjunction with BST Class A, construction shall not begin until the need for anti-stripping additive has been determined. The Contractor shall allow a minimum of seven working days after the necessary aggregate, asphalt, and additive samples have been received in the Headquarter's Materials Laboratory in Tumwater for the necessary tests. Additional time will be required if the Contractor has requested more than one source of asphalt or additive be approved.

5-02.3 Construction Requirements**5-02.3(1) Equipment**

The equipment used by the Contractor shall include scarifying, mixing, spreading, finishing and compacting equipment, an asphalt distributor, and equipment for heating asphalt material and shall be subject to approval by the Engineer before its use on the work.

The distributor shall have a capacity of not less than 1,000 gallons, and shall be so designed, equipped, maintained, and operated that asphalt material of an even heat shall be uniformly applied at the required rate. It shall be equipped with a 10-foot spray bar with

extensions, pressure pump and gauge, volume gauge so located as to be observed easily by the Inspector from the ground, a tachometer to control accurately the speed and spread of asphalt, and two thermometers, one installed permanently in the tank to indicate temperatures of the asphalt at all times. The power for operating the pressure pump shall be supplied by a power unit which will provide a uniform spray from each of the nozzles across the spray bar and extensions.

Rollers shall be self-propelled pneumatic-tired or smooth-wheeled rollers, each weighing not less than 10 tons.

Spreading equipment shall be self-propelled, supported on at least four pneumatic tires, with an approved device for accurately metering and distributing the aggregate uniformly over the roadway surface.

Brooms shall be motorized with a positive means of controlling vertical pressure.

Other equipment necessary to satisfactorily perform the work as specified herein or as designated by the Engineer, shall be subject to approval by the Engineer before its use on the work.

Additional units shall be placed on the work when, in the opinion of the Engineer, it is considered necessary in order to fulfill the requirements of these Specifications, or to complete the work within the time specified.

5-02.3(2) Preparation of Roadway Surface

5-02.3(2)A Untreated Surfaces

The existing roadway surface shall be shaped to a uniform grade and cross-section as shown in the Plans, or as designated by the Engineer.

The roadway shall be sprinkled, bladed, and rolled, after which the top 1 inch of dampened material shall be bladed back and forth across the roadway until the entire roadway surface shows a uniform grading from coarse to fine and conforms to the line, grade, and cross-section shown in the Plans, or staked by the Engineer. The entire surface shall then be rolled with a smooth-wheeled or pneumatic-tired roller, or both, as designated by the Engineer, except that the final rolling shall be accomplished with a smooth-wheeled roller as specified in Section 5-02.3(1). Rolling shall continue until the entire roadway presents a firm and unyielding surface.

In the event the compacted aggregates are of such gradation as to resist penetration of the cutback asphalts, the Contractor shall loosen no more than the upper 1/2 inch of surface and relay without compaction immediately before the prime coat application.

No traffic will be allowed on the repaired surface until the prime coat of asphalt and aggregate is applied.

During the operation of blading and rolling, water shall be applied, if necessary, in the amount and at the locations designated by the Engineer.

Immediately before the prime coat of asphalt is applied, the roadway surface shall be stable and unyielding, dry to medium damp condition, free from irregularities and material segregation, and true to line, grade, and cross-section.

5-02.3(2)B Treated Surfaces

The existing bituminous surface shall be swept with a power broom until it is free from dirt or other foreign matter. Hand push brooms shall be used to clean omissions of the power broom. In addition to power and hand brooms, the use of other equipment may

be necessary to thoroughly clean the roadway prior to the application of asphalt. Berms created by the removal of dirt or other foreign matter shall be evenly distributed over the remaining shoulder or roadway slope.

As soon as the existing surface has been thoroughly cleaned, all holes in the surface, edges, and edge breaks shall be patched. The holes and breaks shall be thoroughly cleaned of all dirt and loose material. For shallow holes and breaks, a small amount of asphalt shall be placed in the bottom of the hole, covered with aggregate and thoroughly tamped or rolled. For holes 1 inch or more in depth, a premix material of aggregate mixed with asphalt as determined by the Engineer shall be used. Asphalt used for patching shall be heated to the temperature specified in Section 5-02.3(3).

Before placing the premix material in the hole, the bottom and edges of the hole shall be swabbed with asphalt. The premixed material shall then be placed and thoroughly tamped or rolled. A small amount of fine screenings shall then be spread on the top of the patch.

Larger depression areas shall be corrected by pre-leveling with premix material or with successive applications of bituminous surface treatment as shown in the Plans or as designated by the Engineer to re-establish a crown-section.

All costs for patching as described above shall be included in the unit contract price per ton for "Asphalt (grade)" and per cubic yard for "Agg. From Stockpile for BST."

5-02.3(2)C Soil Residual Herbicide

Where shown in the Plans, soil residual herbicide shall be applied in accordance with Section 5-04.3(5)D. All other provisions of Section 5-04 pertaining to soil residual herbicide shall apply.

5-02.3(3) Application of Asphalt

Upon the properly prepared roadway surface, asphalt of the grade specified in the Special Provisions shall be uniformly applied with distributors and specified aggregates spread at the following rates:

	Application Rate		Aggregates (lbs. per sq. yd.) Applied
	Asphalt (gal. per sq. yd.) Applied	Aggregate Size (In.)	
Class A			
Prime Coat	0.35-0.55	1/2-1/4 or 3/4-1/2	25-40
Tack Coat	0.35-0.50	1/2-1/4	25-35
		1/4-0	4-6
Class B	0.40-0.60	3/8-1/4	25-40
		1/4-0	4-6
Class C	0.35-0.50	1/2-1/4	20-30
		1/4-0	4-6
Class D	0.20-0.35	3/8-#10	18-25
Pre Seal	0.15-0.20	1/4-0	8-15

The Engineer will determine the application rates.

Longitudinal joints will be allowed at only the centerline of the roadway, the center of the driving lanes, or the edge of the driving lanes.

To ensure uniform distribution of asphalt, prior to beginning work, the distributor bar shall be operated over a pit or vat. A minimum of 100 gallons of material shall remain in the distributor at the end of each shot. To avoid gaps and ridges at transverse junctions of separate applications of asphalt, the Contractor shall spread sufficient building paper over the treated surface to ensure that the spray jets will be functioning normally when the untreated surface is reached. If ordered by the Engineer, the joints shall be cut back to a neat edge prior to placing the building paper.

Should ridges, overlaps, or gaps occur at transverse joints, the Contractor shall repair the defects to the satisfaction of the Engineer. In lieu of repair the Engineer may elect to accept the completed joints and will deduct from monies due or that may become due the Contractor, the sum of \$200 for each joint where the deviations described above are found.

All costs involved in making the corrections to defects described above shall be borne by the Contractor and no payment will be made for this work.

Omissions (skips) by the distributor shall be immediately covered by hand patching with the same grade of asphalt and aggregate used on the project.

The area covered by any one spread of asphalt shall be no more than can be covered with aggregate within one minute from the time of application upon any part of the spread. If field conditions warrant, this time may be increased as designated by the Engineer.

Unless otherwise designated by the Engineer, asphalt shall be spread toward the source of aggregate to avoid injury to the freshly treated surface.

Before they are applied to the roadway, asphalt materials shall be heated to the temperature determined by the Engineer, but within the following limits:

Type and Grade of Asphalt	Distributor Spraying Temperature	
	Min. F	Max. F
LIQUID ASPHALTS		
MC, RC70 Viscosity	120	180
MC, RC250 Viscosity	165	220
MC, RC800 Viscosity	200	255
MC, RC3000 Viscosity	230	280
ASPHALT EMULSIONS		
CSS-1, CSS-1h, STE-1	70	140
CRS-1, CRS-2, CMS-2	125	185
CMS-2s, CMS-2h	125	185

5-02.3(4) Change in Grades of Asphalt

At any time during the progress of the work, the Engineer may order the use of other grades of asphalt materials in substitution of the grades specified in the Special Provisions if the intent of the specifications will be better attained.

If the market price of the grade substituted is higher than that of the grade specified, the difference will be added to the unit contract price for asphalt, or if lower, it will be deducted from the unit contract price.

5-02.3(5) Application Method of Aggregates

After the asphalt has been spread evenly over the roadway surface, aggregates of the type specified shall be evenly applied to the roadway surface by spreader equipment.

All aggregate stockpiles shall be watered down to provide aggregates that are uniformly damp at the time of placement on the roadway.

The aggregate shall be spread in one operation in such a manner that an 8-inch strip of asphalt is left exposed along the longitudinal joint to form a lap for the succeeding applications of asphalt. If necessary, thin or bare spots in the spread of aggregate shall be corrected by hand spreading or by the use of an approved motor patrol grader equipped with a wire broom moldboard or other methods subject to approval of the Engineer.

A minimum of three rollers shall be used. Two pneumatic-tired rollers shall provide two complete coverages immediately behind the spreading equipment for the coarse aggregate. The third roller which provides the final rolling shall be a smooth wheeled roller for Class A construction over untreated bases. A pneumatic-tired roller shall be used in all other situations.

The maximum rate of roller travel shall be limited to 5 mph.

The Contractor shall apply fine aggregates to the roadway with additional spreading equipment immediately following the initial rolling of the coarse aggregate unless otherwise specified in the contract documents or ordered by the Engineer. Excess aggregate shall be removed from the roadway.

The operation of trucks hauling aggregate from the stockpile shall be so regulated that no damage, as determined by the Engineer, will result to the highway or the freshly applied asphalt surface.

The completed surface shall be allowed to cure overnight and shall be broomed off the following morning before 10 a.m. If brooming causes rock to be turned or if the Engineer determines that additional cure is needed, the Contractor shall broom the roadway when directed by the Engineer.

If, after completion of the initial brooming, the Engineer determines the need to remobilize for additional brooming, the Contractor shall rebroom the areas designated by the Engineer.

5-02.3(6) Additional Asphalt and Aggregate

If the application of asphalt or aggregate, or both, is insufficient or excessive for the required results, the Engineer may require the Contractor to make an additional application of one or both materials in accordance with these Specifications, or at the direction of the Engineer. Additional asphalt or aggregate used will be paid for at the unit contract prices for the materials used.

5-02.3(7) Patching and Correction of Defects

Omissions by the distributor or damage to the treated surface of any coat shall be immediately covered by hand patching with asphalt in adequate quantities. Holes which develop in the surface shall be patched in the same manner as specified in Section 5-02.3(2)A. All costs incurred by the Contractor, in coating omissions and patching, shall be included in the unit contract prices for the materials used.

Defects such as raveling, lack of uniformity, or other imperfections caused by faulty workmanship shall be corrected and new work shall not be started until such defects have been remedied.

All improper workmanship and defective materials resulting from overheating, improper handling or application, shall be removed from the roadway by the Contractor and be replaced with approved materials and workmanship at no expense to the Contracting Agency.

If the Engineer determines a fog seal is necessary at any time during the life of the contract, the Contractor shall apply a fog seal of CSS-1 at the rate of 0.07 to 0.18 (0.02 to 0.05 residual) gallons per square yard. The emulsified asphalt shall be diluted with water at a rate of one part water to one part emulsified asphalt unless otherwise directed by the Engineer.

5-02.3(8) Progress of Work

The Contractor shall organize the work so that progress will be equivalent to at least 3 centerline miles work per day of completed prime or tack coat on Class A bituminous surface treatment, or 4 miles work per day of completed roadway on Classes B, C, or D bituminous surface treatment. No longitudinal joints shall remain open overnight.

5-02.3(9) Protection of Structures

All bridge handrails, guardrails, curbs, road signs, or other facilities shall be protected from splashing of the asphalt. All costs incurred by the Contractor in necessary protective measures shall be included in the unit contract prices for the various bid items of work involved.

5-02.3(10) Unfavorable Weather

Asphalt shall not be applied to wet material. Subject to the determination of the Engineer, asphalt shall not be applied during rainfall, sand or dust storms, or before any imminent storms that might damage the construction. The Engineer will have the discretion as to whether the surface and materials are dry enough to proceed with construction.

The application of any asphalt to the roadway shall be restricted to the following conditions:

The roadway surface temperature shall be at least 60 F and the air temperature at least 60 F and rising, or

The air temperature shall be not less than 70 F when falling and the wind shall be less than 10 miles per hour as estimated by the Engineer.

No asphalt shall be applied which cannot be covered one hour before darkness. The Engineer may require the Contractor to delay application of asphalt until the atmospheric and roadway conditions are satisfactory.

Construction of bituminous surface treatments on any traveled way shall not be carried out before May 15 or after August 15 of any year except upon written order of the District Administrator.

5-02.3(11) Anti-Stripping Additive

When requested by the Engineer, an anti-stripping additive shall be added to the asphalt material in accordance with Section 9-02.4.

5-02.4 Measurement

Processing and finishing will be measured by the mile to the nearest 0.01 mile along the main line roadway. All related supplemental roadways and irregular shaped areas will be incidental.

Asphalt of the grade or grades specified will be measured by the ton in accordance with Section 1-09.1.

Asphalt for fog seal will be measured by the ton, before dilution, in accordance with Section 1-09.

Aggregate from stockpile, and furnishing and placing aggregate will be measured by the cubic yard in trucks at the point of delivery on the roadway.

Additional brooming will be measured by the hour.

Water will be measured in accordance with Section 2-07.

5-02.5 Payment

Payment will be made in accordance with Section 1-04.1, for each of the following bid items that are included in the proposal:

"Processing and Finishing", per mile.

"Asphalt (grade)", per ton.

"Asphalt for Fog Seal", per ton.

"Anti-Stripping Additive", by force account.

"Anti-Stripping Additive" will be paid for in accordance with Section 1-09.6 except that no overhead, profit, or other costs will be allowed. Payment will be made only for the invoice cost of the additive. The quantity of asphalt material shall not be reduced by the quantity of anti-stripping additive. For the purpose of providing a common proposal for all bidders, the Contracting Agency has entered an amount in the proposal to become a part of the total bid by the Contractor.

"Agg. from Stockpile for BST", per cubic yard.

"Furnishing and Placing Crushed (type)", per cubic yard.

"Additional Brooming", per hour.

"Water", per M gal.

If the proposal does not include a bid item for water, the Contractor shall dampen stockpiled or furnished aggregate as required, and the cost thereof shall be included in other items of the work.

5-04 ASPHALT CONCRETE PAVEMENT**5-04.1 Description**

This work shall consist of one or more courses of plant mixed asphalt concrete placed on a prepared foundation or base in accordance with these Specifications and in conformity with the lines, grades, thicknesses, and typical cross-sections shown in the Plans or established by the Engineer.

Asphalt concrete shall be composed of asphalt and aggregate which, with or without the addition of mineral filler and blending sand as may be required, shall be mixed in the proportions specified to provide a homogeneous, stable, and workable mixture.

Asphalt concrete Class A, Class B, Class D, Class F, and Class G are designated as leveling or wearing courses. Asphalt concrete Class E is designated as a pavement base course. With the exception of asphalt concrete Class D, all mixtures are considered dense graded asphalt concrete.

5-04.2 Materials

Materials shall meet the requirements of the following sections:

Asphalt Cements	9-02.1(4)
Recycling Agent	9-02.1(5)
Cationic Emulsified Asphalt	9-02.1(6)
Anti-Stripping Additive	9-02.4
Aggregates	9-03.8
Blending Sand	9-03.8(4)
Mineral Filler	9-03.8(5)

The various mineral materials may be furnished in whole or in part by the Contracting Agency for the manufacture of asphalt concrete, or the Contractor may be required to furnish them. If any of these mineral materials are not provided by the Contracting Agency, it shall be understood that the Contractor shall furnish such materials in the amounts required for the designated mix. Mineral materials include coarse and fine aggregates, blending sand, and mineral filler.

The Contractor shall have the option of utilizing asphalt concrete removed under the contract, if any, or old asphalt concrete from an existing stockpile, or supplying all new materials in the production of the asphalt concrete pavement or any combination of the foregoing. If removed from an existing stockpile, the old asphalt concrete used must be uniform in gradation, asphalt content, and asphalt viscosity. If not from an identified and approved source, the aggregates must meet degradation and hardness requirements. Should the Contractor elect to use 20 percent or less of recycled materials, the recycled materials need not be uniform as long as the asphalt concrete meets the specifications for the class specified. Recycled materials shall not be used in asphalt concrete Class D.

When aggregates or a source for the production of aggregates is provided by the Contracting Agency, the approximate percentage of asphalt required in the mixture for the particular class of pavement will be set forth in the special provisions. The percentage is based upon a midline gradation mix design for the source provided.

The grade of paving asphalt shall be AR-4000W.

Production of aggregates shall comply with the requirements of Section 3-01.

Preparation of stockpile site, the stockpiling of aggregates, and the removal of aggregates from stockpiles shall comply with the requirements of Section 3-02.

5-04.3 Construction Requirements

5-04.3(1) Asphalt Mixing Plant

Sufficient storage space shall be provided for each size of aggregate. The different aggregate sizes shall be kept separated until they have been delivered to the cold elevator feeding the plant except that aggregates produced meeting the requirements of Section 9-03.8(3)B need not be separated. The storage yard shall be maintained neat and orderly and the separate stockpiles shall be readily accessible for sampling.

Plants used for the preparation of asphalt concrete shall conform to all requirements of Section 5-04.3(1)A except that scale requirements shall apply only where weight proportioning is used. In addition, batch plants shall conform to the requirements of Section 5-04.3(1)B; continuous mix plants shall conform to the requirements of Section 5-04.3(1)C; and rotary drum plants shall conform to the requirements of Section 5-04.3(1)D.

5-04.3(1)A Requirements for All Plants

Except as noted in Section 5-04.3(1)E, all plants shall meet the following requirements:

1. The asphalt plant shall have a minimum capacity rating by the manufacturer as follows:
 For projects involving 5,000 tons or more:
 Batch plants — 2,000 lbs. per batch.
 Continuous mix and rotary drum plants — 100 tons per hour.
 For projects involving less than 5,000 tons:
 Batch plants — 1,000 lbs. per batch.
 Continuous mix and rotary drum plants — 45 tons per hour.
2. Smoke and dust control. When the asphalt plant is erected at a site for the primary purpose of producing mixtures for a specific project, dust and smoke from the asphalt plant shall be eliminated to the extent that they will cause no inconvenience to property owners in the area or damage to their property. The Contractor shall be required to install supplemental equipment, when necessary, to control the dust and smoke to meet the requirements of Section 1-07.1.
3. Scales. Plant and truck scales shall meet the requirements of Section 1-09.2.
4. Equipment for preparation of asphalt material. Tanks for the storage of asphalt material shall be equipped to heat and hold the material at the required temperatures. The heating shall be accomplished by steam coils, electricity, or other approved means so that no flame shall be in contact with the tank. The circulating system for the asphalt material shall be designed to ensure proper and continuous circulation during the operating period. Provision shall be made for measuring the asphalt in the storage tank and a valve shall be placed in the supply line to the mixer for sampling the material.
5. Feeder for drier or drum mixer. The plant shall be provided with accurate mechanical means for uniformly feeding the aggregate into the drier so that uniform production and uniform temperature will be obtained. The feeder for blending sand, when required, shall be capable of providing a consistent, uniform flow in the amount designated by the Engineer.
6. Screens. Plant screens, capable of screening all aggregates to the specified sizes and proportions and having normal capacities in excess of the full capacity of the mixer, shall be provided.

7. Bins. The plant shall include storage bins of sufficient capacity to supply the mixer when it is operating at full capacity. Bins shall be arranged to ensure separate and adequate storage of appropriate fractions of the aggregates. Separate dry storage shall be provided for mineral filler when used and the plant shall be equipped to feed such material into the mixer. Each bin shall be provided with overflow pipes, sized and located to prevent material backing up into other compartments or bins. Each compartment shall be provided with an outlet gate, constructed so there shall be no leakage when closed. The gates shall close quickly and completely. Bins shall be constructed so samples can be readily obtained. Bins shall be equipped with adequate tell-tale devices to indicate the level of the aggregates in the bins at the lower quarter points.
8. Asphalt control unit. Satisfactory means, either by weighing or metering, shall be provided to obtain the proper amount of asphalt material in the mix. Means shall be provided for checking the quantity or rate of flow of asphalt material into the mixer.

The asphalt may also be proportioned by a device which sprays the asphalt into the mixer through six or more nozzles, and which weighs or proportions the material for each batch by a positive rotating meter which is calibrated in pounds. The metering device shall have an established background of service and shall be approved by the Engineer.

9. Thermometric equipment. An armored thermometer of adequate range in temperature reading shall be fixed in the asphalt feed line at a suitable location near the charging valve at the mixer unit.

The plant shall also be equipped with either an approved dial-scale, a mercury actuated thermometer, an electric pyrometer, or other approved thermometric instrument placed at the discharge chute of the drier to automatically register or indicate the temperature of the heated aggregates. This device shall be in full view of the plant operator. The Engineer may require replacement of any thermometer with an approved temperature-recording apparatus for better regulation of the temperature of aggregates.

10. Dust collector. The plant shall be equipped with a dust collector constructed to waste or return uniformly to the hot elevator all or any part of the material collected.

When a baghouse is used for dust control, the Contractor shall be able to introduce the material returned from the baghouse into the mixture at a uniform and continuous rate. Accurate mechanical means shall be provided for uniformly feeding the fines into the aggregate stream. To accomplish this, the Contractor shall provide a surge hopper with a holding capacity sufficient to accumulate the baghouse fines or shall have a variable speed mechanical feed interlocked to the plant which will prevent any variance in feed into the aggregate stream. Either method shall provide uniform and continuous return of the well-graded fine materials and be provided with a method of withdrawing the surplus fines independently for disposal.

11. Burner fuel. The plant burner fuel shall be restricted to the use of propane, butane, natural gas, methane, coal, No. 1 or No. 2 fuel oil, or other acceptable burner fuel as determined by the Engineer.

5-04.3(1)B Requirements for Batch Plants

In addition to the requirements listed under Section 5-04.3(1)A, batch plants shall meet the following requirements:

1. The plant shall include a drier or driers which continuously agitate the aggregate during the heating and drying process, and be capable of preparing aggregates to specification requirements.
2. Weigh box or hopper. The equipment shall include a means for accurately weighing each size of aggregate in a weigh box or hopper suspended on scales and of ample size to hold a full batch without hand raking or running over. The gate shall close tightly so that no material is allowed to leak into the mixer while a batch is being weighed.
3. Asphalt control. The equipment used to measure the asphalt material shall be accurate to plus or minus 0.5 percent. The asphalt bucket shall be a nontilting type with a loose sheet metal cover. The length of the discharge opening or spray bar shall be not less than 75 percent of the length of the mixer and it shall discharge directly into the mixer. The asphalt bucket, its discharge valve or valves and spray bar shall be adequately heated. Steam jackets, if used, shall be efficiently drained and all connections shall be constructed so they will not interfere with the efficient operation of the asphalt scales. The capacity of the asphalt bucket shall be at least 15 percent in excess of the weight of asphalt material required in any batch. The plant shall have an adequately heated quick-acting, nondrip, charging valve located directly over the asphalt material bucket.

The indicator dial shall have a capacity of at least 15 percent in excess of the quantity of asphalt material used in a batch. The controls shall be constructed so they may be locked at any dial setting and will automatically reset to that reading after the addition of asphalt material to each batch. The dial shall be in full view of the mixer operator. The flow of asphalt material shall be automatically controlled so it will begin when the dry mixing period is over. All of the asphalt material required for one batch shall be discharged in not more than 15 seconds after the flow has started. The size and spacing of the spray bar openings shall provide a uniform application of asphalt material the full length of the mixer. The section of the asphalt line between the charging valve and the spray bar shall be provided with a valve and outlet for checking the meter when a metering device is substituted for an asphalt material bucket.

4. Mixer. The batch mixer shall be an approved type capable of producing a uniform mixture meeting the requirements of these Specifications. If not enclosed, the mixer box shall be equipped with a dust hood to prevent loss of dust.

Clearance of the blades from all fixed and moving parts shall not exceed 1 inch unless the maximum diameter of the aggregate in the mix exceeds 1 1/2 inches, in which case the clearance shall not exceed 1 1/2 inches.

5. Mixing time. The plant shall be capable of regulation of the mixing time as specified in Section 5-04.3(8) in 5 second increments.
6. Automatic controls. All projects using a batch mixer involving 5,000 tons or more of asphalt concrete, except Class F, shall conform to the following provisions. Automatic control of batch mixing operations may be used providing the requirements of this section are met.

The proportioning and timing devices shall be automatic to the extent that the only manual operation required for the proportioning and mixing of materials for one batch shall be a single operation of a switch or starter.

The mixing plant shall be equipped with automatic weight proportioning devices to monitor and control the weights of the several components of aggregates and of the asphalt, plus timing lock devices to monitor and control the position of the aggregate weigh hopper dump gate, the asphalt bucket discharge valve, and the mixer discharge gate.

Withdrawal from the aggregate bins and the discharge of the weigh hopper shall be so interlocked that the weigh hopper cannot discharge until the required quantity of aggregate from each bin has been deposited therein. The weigh hopper may be a single compartment, individual weight control type, or of the divided compartment, preset volume type. When the single compartment, individual weight control type is used, the automatic scale weight system shall discharge and weigh material from one bin at a time. When the preset volume weigh hopper is used, the automatic control system shall check the total weight of each aggregate batch and provision shall be made to allow the Engineer to check easily and quickly the individual aggregate weights at any time.

The timing lock devices shall be actuated by the opening of the aggregate weigh hopper dump gate. They shall lock the asphalt bucket discharge valve until preset dry mixing time is expired and shall lock the mixer discharge gate throughout the preset dry and wet mixing periods. The control of the timing shall be flexible and capable of being set at intervals of not more than 5 seconds throughout cycles up to 60 seconds.

The dials of the timing locks and automatic weighing controls shall be so arranged that the time interval and mass proportion controls may be locked by the Engineer.

5-04.3(1)C Requirements for Continuous Mix Plants

In addition to the requirements listed under Section 5-04.3(1)A, continuous mix plants shall meet the following requirements:

1. Aggregate proportioning. The plant shall include a means for accurately proportioning each size of aggregate.

The plant shall have a feeder mounted under each compartment bin. Each compartment bin shall have an accurately controlled individual gate to form an orifice for volumetrically measuring the material drawn from each compartment. The feeding orifice shall be rectangular with one dimension adjustable by positive mechanical means provided with a lock.

Indicators shall be provided for each gate to show the respective gate opening in inches.

The feeder belt or drive system shall be adjustable to various speeds and calibrated with various gate openings for the material to be used.

2. Weight calibration of aggregate feed. The plant shall include a means for calibration of gate openings by weighing test samples. Provision shall be made so that materials fed out of individual orifices may be bypassed to individual test boxes. The plant shall be equipped to conveniently handle individual test samples weighing not less than 200 pounds.

3. Synchronization of aggregate feed and asphalt material feed. Satisfactory means shall be provided to afford positive interlocking control between the flow of aggregate from the bins and the flow of asphalt material from the meter or other proportioning device. This control shall be accomplished by interlocking mechanical means or by any other positive method satisfactory to the Engineer.

A warning device shall be provided to alert the plant operator any time the level of material in any one bin is so low that uniform feed is discontinued.

4. Mixer. The plant shall include a continuous mixer of an approved type, adequately heated and capable of producing a uniform mixture meeting the requirements of these Specifications. It shall be equipped with a discharge hopper with dump gates which will permit rapid and complete discharge of the mixture. The paddles shall be adjustable for angular position on the shafts and reversible to retard the flow of the mix. The mixer shall have a manufacturer's plate giving the net volumetric contents of the mixer at the several heights inscribed on a permanent gauge. Charts shall be provided showing the rate of feed of aggregate per minute for the aggregate being used.

5-04.3(1)D Requirements for Rotary Drum Plants

In addition to the requirements listed under Section 5-04.3(1)A, rotary drum plants shall meet the following requirements:

1. The plant shall have a feeder capable of uniformly introducing the aggregate into the drum. The aggregate feeder shall be synchronized with the asphalt material feed. Satisfactory means shall be provided to afford positive interlocking control between each aggregate cold feed bin, aggregate feed, and the asphalt feed so the plant will automatically activate a warning device if the feed of either aggregate or asphalt is interrupted.
2. The plant shall have the mixing capability to provide a uniform mixture meeting the requirements of these Specifications.
3. The asphalt material feed shall have positive recording capabilities so the amount of asphalt incorporated into the mix during any given period of time may be read directly.

5-04.3(1)E Screenless Plants

If the Contractor elects to produce aggregate in accordance with Section 9-03.8(3)B, Item 6 — Screens and Item 7 — Bins of Section 5-04.3(1)A will not be required provided the completed mixture meets the specifications as listed in Section 9-03.8(6) for the class of mix being produced.

5-04.3(2) Hauling Equipment

Trucks used for hauling asphalt concrete mixtures shall have tight, clean, smooth metal beds which have been thinly coated with a minimum amount of paraffin oil, or other approved material to prevent the mixture from adhering to the beds. Each truck shall have a cover of canvas or other suitable material of sufficient size to protect the mixture from the weather.

When dump truck beds are sprayed with oil, the excess oil shall be drained prior to filling with the asphalt mixture. For hopper trucks, the conveyer shall be in operation during the process of oiling the bed.

5-04.3(3) Asphalt Pavers

Asphalt pavers shall be self-contained, power-propelled units, provided with an activated screed or strike-off assembly, heated if necessary, and capable of spreading and finishing courses of asphalt plant mix material in lane widths applicable to the specified typical section and thicknesses shown in the Plans.

The screed or strike-off assembly shall effectively produce a finished surface of the required evenness and texture without tearing, shoving, or gouging the mixture. Any bolt-on extensions over 1 foot in length on either side of the paver shall have the same equipment as the rest of the paver. Hydraulic extenders without screeds, augers, and vibration shall not be used in the traveled way.

When laying mixtures, the paver shall be operated at a uniform forward speed consistent with the plant production rate and roller train capacity to result in a continuous operation. The auger speed and flight gate opening shall be adjusted to coordinate with the operation.

The paver shall be equipped with automatic screed controls with sensors for either or both sides of the paver. The controls shall be capable of sensing grade from an outside reference line, sensing the transverse slope of the screed, and providing automatic signals which operate the screed to maintain the desired grade and transverse slope. The sensor shall be constructed so it will operate from a reference line or a multi-footed ski-like arrangement.

The transverse slope controller shall be capable of maintaining the screed at the desired slope within plus or minus 0.1 percent. The paver shall be equipped with automatic feeder controls, properly adjusted to maintain a uniform depth of material ahead of the screed.

Manual operation will be permitted in the construction of irregularly shaped and minor areas. These areas, as determined by the Engineer, may include, but are not limited to, gore areas, road approaches, left-turn channelizations, and tapers.

When specified in the contract, reference lines will be required for both outer edges of the traveled way for each main line roadway for vertical control. Horizontal control utilizing the reference line will be permitted. The grade and slope for intermediate lanes shall be controlled automatically from reference lines or by means of a multi-footed ski and a slope control device. When the finish of the grade prepared for paving is superior to the established tolerances, and, when in the opinion of the Engineer, further improvement to the line, grade, cross-section, and smoothness can best be achieved without the use of the reference line, a multi-footed ski-like arrangement may be substituted subject to the continued approval of the Engineer. After paving the first lane, a joint matcher may be used subject to the approval of the Engineer. The use of the reference line shall be reinstituted immediately whenever the Contractor fails to maintain a superior pavement, or rhythmic undulations occur, or the surface smoothness of the course being paved fails to meet the requirements for wearing course. The reference line may be removed after the completion of the first course of asphalt concrete when approved by the Engineer and subject to reinstallation at the Contractor's expense.

The Contractor shall furnish and install all pins, brackets, tensioning devices, wire, and accessories necessary for satisfactory operation of the automatic control equipment. The Contractor shall submit samples of the above items along with the methods and procedures to the Engineer for approval prior to installation.

5-04.3(4) Rollers

Rollers shall be of the steel wheel, vibratory, or pneumatic tire type, in good condition, capable of reversing without backlash, and shall be operated at speeds slow enough to avoid displacement of the mixture. The number and weight of rollers shall be sufficient to compact the mixture as required in Section 5-04.3(10). The use of equipment which results in excessive crushing of the aggregate will not be permitted. Rollers producing pickup, washboard, uneven compaction of the surface or other undesirable results will be rejected by the Engineer.

The following specifications shall apply to the various types of rollers:

1. Vibratory Rollers
 - a. A variable amplitude will be required, with at least 2 settings.
 - b. A variable frequency with a 2,000 VPM minimum.
 - c. The maximum rate of travel under vibration shall be limited to 3 mph.
 - d. Pneumatic propulsion on surface courses shall be limited to smooth tires that will not leave visible tracks.
2. Pneumatic Tired Rollers
 - a. The maximum rate of travel shall be limited to 5 mph.
 - b. Skirts shall be firmly affixed to the perimeter of the roller and shall uniformly extend to within 1 inch of the pavement surface.
3. Steel Wheel Rollers
 - a. The maximum rate of travel shall be limited to 4 mph.

5-04.3(5) Conditioning of Existing Surface

When the surface of the existing pavement or old base is irregular, it shall be brought to uniform grade and cross-section as approved by the Engineer.

Preleveling of uneven or broken surfaces over which asphalt concrete is to be placed is required and may be accomplished by using the specified asphalt concrete placed with an asphalt paver, a motor patrol grader, or by hand raking, as approved by the Engineer. When asphalt concrete pavement Class G is being constructed as a wearing course overlay, upon approval of the Engineer, asphalt concrete pavement Class A or Class B may be used as an alternate for preleveling, provided there is no increase in cost to the Contracting Agency for preleveling.

After placement, the asphalt concrete used for preleveling shall be compacted thoroughly.

5-04.3(5)A Preparation of Existing Surfaces

Before construction of an asphalt concrete pavement on an existing paved surface, all fatty asphalt patches, grease drippings, and other objectionable matter shall be entirely removed from the existing pavement. All excess asphalt joint filler shall be completely removed and all premolded joint filler shall be removed to at least 1/2 inch below the surface of the existing pavement. All types of existing pavement or bituminous surfaces shall be thoroughly cleaned by sweeping to remove dust and other foreign matter.

A tack coat of asphalt applied at the rate of 0.02 to 0.08 gallons per square yard of retained asphalt shall be applied to all paved surfaces on which any course of asphalt concrete is to be placed or abutted. The spreading equipment shall be equipped with a spray bar with extensions, pressure pump and gauge, tachometer to accurately control the speed and the spread of asphalt, a thermometer to indicate the temperature of the asphalt,

and hand operated spray equipment for use only on inaccessible and irregularly shaped areas. The power for operating the pressure pump shall be supplied by a power unit which will develop a minimum of 25 psi at the spray bar. When asphalt concrete pavement Class D is being constructed, a tack coat of CRS-2 shall be applied to the existing surface at a rate of 0.12 to 0.20 (0.08 to 0.12 residual) gallons per square yard or as otherwise ordered by the Engineer.

The tack coat shall be a heated cutback asphalt, or emulsified asphalt, mixing grade, as directed by the Engineer. The emulsified asphalt may be diluted with water at a rate not to exceed one part water to one part of emulsified asphalt, as directed by the Engineer.

When asphalt concrete pavement is to be constructed over an existing paved or oiled surface, in addition to the preparation as outlined above, all holes and small depressions shall be filled with an appropriate class of asphalt concrete mix. The surface of the patched area shall be leveled and compacted thoroughly.

5-04.3(5)B Preparation of Untreated Roadway

The existing roadway shall be prepared and the roadway primed as provided in Section 5-02.3(2)A, except that only one application of asphalt and one application of aggregate, which shall conform to aggregate for asphalt concrete Class B as listed in Section 9-03.8 or other granular materials approved by the Engineer, will be required. All other provisions of Section 5-02 pertaining to bituminous surface treatment Class A shall apply, except as hereinafter modified.

The prime coat shall be applied over the full length of the project, and asphalt concrete pavement shall not be placed until the prime coat has cured for 5 days unless otherwise approved by the Engineer.

Should any holes, breaks, or irregularities develop in the roadway surface after the prime coat has been applied, they shall be patched with asphalt concrete, as described in Section 5-04.3(5)A, in advance of placing the asphalt concrete. The Contractor shall maintain the completed prime coat by blading or brooming with motor patrol graders, as approved by the Engineer, until the asphalt concrete is placed.

After the maintenance, patching or repair work has been completed and immediately prior to placing the asphalt concrete pavement, the surface of the prime coat shall be swept clean of all dirt, dust, or other foreign matter.

When the prime coat application is not specified in the Special Provisions or shown in the Plans, the Contractor shall prepare the untreated roadway as described above and shall omit the prime coat treatment. The asphalt concrete pavement shall be constructed on the prepared subgrade.

In areas used as turnouts or which will receive heavy service, the Engineer may order a change in the grade to provide a greater depth of pavement.

The Contractor shall prepare untreated shoulders and traffic islands by blading and compacting to provide a sound base for paving and shall omit the prime coat treatment. The asphalt concrete pavement shall be constructed on the prepared subgrade.

If the Contractor protects the completed untreated surfacing materials to the degree that the surface meets the requirements of Section 5-02.3(2)A at the time of construction of the prime coat or the construction of the pavement if the prime coat is not required, the Contractor will not be required to perform the work specified in Section 5-02.3(2)A but shall be compensated for the item of work preparation of untreated roadway.

5-04.3(5)C Crack Sealing

When the proposal includes a pay item for crack sealing, all cracks and joints shall be cleaned with a stiff-bristled broom and compressed air. After cleaning, all cracks less than $\frac{1}{4}$ inch in width shall be filled with straight CSS-1 emulsified asphalt and topped with sand. All cracks and joints greater than $\frac{1}{4}$ inch and less than $\frac{3}{4}$ inch in width shall be filled with either a sand slurry or rubberized asphalt. Cracks larger than $\frac{3}{4}$ inch in width shall be filled with a sand slurry. Application of the sand slurry or rubberized asphalt shall be as follows:

1. **Sand Slurry.** The sand slurry shall consist of approximately 20 percent CSS-1 emulsified asphalt, approximately 2 percent Portland cement, water (if required), and the remainder clean $\frac{1}{4}$ inch-0 paving sand. The mixture shall be poured into the cracks and joints until full. The following day, any cracks or joints which are not completely filled shall be topped off with the slurry. After sealing, the filler shall be broomed or squeegeed flush with the existing pavement surface and allowed to cure prior to constructing the asphalt concrete overlay.
2. **Rubberized Asphalt.** The sealant material shall conform to the requirements of Section 9-04.10 and shall be applied in accordance with the manufacturer's recommendations. These recommendations shall be furnished to the Engineer by the Contractor prior to the start of work and shall include recommended heating time and temperature, allowable storage time and temperatures after initial heating, allowable reheating criteria, and application temperature range.

The cracks shall be completely dry before being filled with the rubberized asphalt. Filling shall be controlled to confine the material within the crack or joint. If, in the opinion of the Engineer, the Contractor's method of filling results in an excessive amount of sealant on the pavement surface, filling shall be stopped and the method changed. Any overflow shall be cleaned from the pavement surface.

5-04.3(5)D Soil Residual Herbicide

Where shown in the Plans, the Contractor shall apply one application of an approved soil residual herbicide. Paving shall begin within 24 hours after application of the herbicide. Any area that has not been paved within the time limit or that has been rained on, shall be treated again at the Contractor's expense. The herbicide shall be applied uniformly in accordance with the manufacturer's recommendations.

The material to be used shall be registered for use under pavement in the Contracting Agency of Washington by the Washington Contracting Agency Department of Agriculture. Before use, the Contractor shall receive from the Engineer approval of the material to be used and the proposed rate of application. The following information shall be included in the request for approval of the material: Name of the material, Contracting Agency registration number, manufacturer, and proposed rate of application.

Application of the herbicide shall be performed in accordance with Section 8-02.3(2)A.

5-04.3(5)E Pavement Repair

The Contractor shall excavate, furnish, and place asphalt concrete pavement as backfill for pavement repair areas in accordance with the details shown in the Plans and as staked by the Engineer.

The actual excavation depth may vary to a maximum depth of 1-foot maximum, depending upon where stable foundation material is encountered, as determined by the Engineer.

The minimum width of any pavement repair area shall be 3 feet unless shown otherwise in the Plans. All pavement repair areas shall be sawcut before removal, or shall be removed by a pavement grinder approved by the Engineer.

Asphalt for tack coat shall be required as specified in Section 5-04.3(5)A, and shall be applied to all edges of existing pavement in the pavement repair area.

The Contractor shall excavate only within one lane at a time. The areas shall be excavated, backfilled, and compacted within the same day's working shift, in accordance with the details shown in the Plans and to the satisfaction of the Engineer.

Excavated materials will become the property of the Contractor for disposal off the right of way.

The Contractor shall conduct the excavation operations in a manner that will protect the pavement areas not designated to be removed. Pavement not designated to be removed that is damaged as a result of the Contractor's operations shall be repaired by the Contractor to the satisfaction of the Engineer at no cost to the Contracting Agency.

Placement of the asphalt concrete backfill shall be accomplished in lifts. Each lift shall not exceed 0.35 foot compacted depth. Compaction shall be accomplished by mechanical tamper or a roller as approved by the Engineer.

Asphalt concrete pavement for pavement repair shall be asphalt concrete pavement Class A, B, E, or F at the Contractor's option, unless otherwise specified in the contract.

5-04.3(6) Heating of Asphalt Material

The asphalt shall be heated to a maximum of 350 F. The asphalt shall be heated in a manner that will avoid local overheating and provide a continuous supply of asphalt material to the mixer at a uniform temperature plus or minus 25 F from the temperature ordered by the Engineer.

5-04.3(7) Preparation of Aggregates

The aggregates shall be stockpiled according to the requirements of Section 9-03.8(3). The aggregates shall be removed from stockpile(s) in a manner to ensure a minimum of segregation when being moved to the asphalt plant for processing into the final mixture.

5-04.3(7)A Mix Design

Once the crushing operation has stabilized to the satisfaction of the Engineer, a representative sample will be obtained from the stockpiled aggregates. A sample of the stockpiled blending sand, if needed, will also be required at this time. The Contractor shall propose a production mix gradation which shall be the basis for the job mix formula for the mix design. The proposed gradation may vary from the production values from aggregate production to reflect anticipated plant operations and adjustments as necessary to ensure compatibility. Paving operations shall not proceed until a mix design is furnished by the Engineer. The Contractor shall allow a minimum of 15 working days after the job mix design proposal, aggregate samples, and asphalt have been received in the Headquarters Materials Laboratory in Tumwater for the preparation of a job mix design. Additional time will be required if the Contractor has requested that more than one source of asphalt cement be approved.

When old asphalt concrete is proposed for inclusion in the mix, the Contractor shall submit a design for approval, including representative samples taken in the presence of the Engineer, and the approximate proportions of the various materials (old asphalt concrete, new aggregate, recycling agent, new paving asphalt) to be used. Upon tentative approval of the approximate proportions proposed by the Contractor, the materials will be proportioned together for a job mix design. Approval of the mix design will be based upon meeting the specification requirements of Section 9-03.8(2) for the specified Class of ACP, or as shown in the Special Provisions. In addition, for mix design approval, the blend of recovered paving asphalt plus recycling agent and additional paving asphalt shall meet the requirements for AR-4000W. The Contractor shall allow 15 working days for this approval and design once the material has been received at the Materials Laboratory. Additional time may be required if the proportions will not make an adequate design as determined by the Engineer, or if the Contractor requests more than one recycling agent or paving asphalt source approval. The Contractor is also advised that production of the asphalt concrete shall not commence until the job mix design has been established.

The Contractor shall obtain the Engineer's approval prior to changing the source of asphalt cement during the production of asphalt concrete. Blending of asphalt from different sources will not be permitted.

5-04.3(8) Mixing

The prepared aggregates shall be combined in the mixer in the amount of each fraction of aggregates as specified or as directed by the Engineer. The asphalt material shall be measured or gaged and introduced into the mixer in the amount determined by the Engineer.

After the required amounts of aggregate and asphalt material have been introduced into the mixer, unless otherwise specified, the materials shall be mixed until a complete and uniform coating of the particles and a thorough distribution of the asphalt material throughout the aggregate is ensured. Wet mixing time shall be sufficient to produce 95 percent coated particles as determined by WSDOT Test Method No. 714.

When discharged, the temperature of the mix shall not exceed 325 F except that the temperature for mixes designed for asphalt concrete Class D shall not exceed 260 F. A maximum water content of 2 percent in the mix, at discharge, will be allowed providing the water causes no problems with handling, stripping, or flushing. In this case, the moisture content shall be reduced as directed by the Engineer.

Storing or holding of the asphalt concrete mixture in approved storage facilities will be permitted during the daily operation but in no event shall the materials be held for more than 24 hours. Materials held for more than 24 hours after mixing shall be rejected and disposed of by the Contractor at no expense to the Contracting Agency. The storage facility shall have a visible device located at the top of the cone or about the third point to indicate the amount of material in storage. No material shall be accepted from the storage facility when the material in storage is below the top of the cone of the storage facility, except at the end of the working day.

5-04.3(8)A Acceptance Sampling and Testing

1. General. Acceptance of asphalt cement concrete shall be as provided under statistical or nonstatistical acceptance. Determination of statistical or nonstatistical acceptance shall be based on proposal quantities and shall consider the total of all bid items involving mix of a specific class.

Dense graded mixes (asphalt concrete pavement Classes A, B, E, F, and G) will be evaluated for quality of gradation and asphalt content.

Open graded mixes (asphalt concrete pavement Class D) will be evaluated for quality of gradation only, based on samples taken from the cold feed.

Statistical acceptance procedures will apply only to contracts advertised, awarded, and administered by WSDOT, unless specifically provided otherwise in the Special Provisions. Contracting agencies other than WSDOT must specifically invoke statistical acceptance in their Special Provisions if it is desired.

Statistical Acceptance, (1) applies only to WSDOT projects, (2) is administered under the provisions of Section 5-04.5(1) for Quality Assurance Price Adjustments and evaluation of quality, and (3) will be used for a class of mix when the proposal quantities for that class of mix exceed 2,500 tons.

Nonstatistical Acceptance will be used, (1) for a class of mix when the proposal quantities for that class of mix are less than 2,500 tons, and (2) all contracts advertised, awarded, and administered by agencies other than WSDOT.

2. Aggregates. Aggregates will be accepted for sand equivalent and fracture based on their conformance to the requirements of Section 9-03.8(2) without recourse to statistical evaluation.

3. Asphalt Concrete Mixture

A. Sampling

(1) A sample will not be obtained from either the first or last 25 tons of mix produced in each production shift.

(2) Samples for compliance of gradation and asphalt cement content will be obtained on a random basis from the hauling vehicle. The Contractor shall provide adequate platforms to enable samples to be obtained in accordance with WSDOT Test Method 712. The platforms shall allow the sample to be taken without the Engineer entering the hauling vehicle.

- B. Definition of Sampling Lot and Sublot. For the purpose of acceptance sampling and testing, a lot is defined as the total quantity of material or work produced for each job mix formula (JMF), placed and represented by randomly selected samples tested for acceptance. All of the test results obtained from the acceptance samples shall be evaluated collectively and shall constitute a lot. Only one lot per JMF will be expected to occur. The JMF (Job Mix Formula) is defined in Section 9-03.8(6)A (Basis of Acceptance).

The Contractor may request a change in the JMF. If the request is approved, all of the material produced up to the time of the change will be evaluated on the basis of available tests and a new lot will begin. The quantity represented by each sample will constitute a sublot. Sampling and testing for statistical acceptance shall be performed on a random basis at the frequency of one sample per sublot, with a minimum of five sublots per class of mix. Sublot size shall be determined to the nearest 100 tons to provide not less than five uniform sized sublots, based on proposal quantities, with a maximum sublot size of 800 tons.

Sampling and testing for nonstatistical acceptance shall be performed on a random basis at a minimum frequency of one sample for each subplot of 400 tons or each day's production, whichever is least. When proposal quantities exceed 1,200 tons for a class of mix under nonstatistical acceptance, subplot size shall be determined to the nearest 100 tons to provide not less than three uniform sized sublots, based on proposal quantities, with a maximum subplot size of 800 tons.

- C. **Test Results.** The Engineer will furnish the Contractor with a copy of the results of all acceptance testing performed in the field by 7:00 a.m. the morning of the next workday after sampling, or for nighttime work within four hours after the beginning of the next paving shift. The Engineer will also provide, by noon of the next workday after sampling, the Composite Pay Factor (CPF) of the completed sublots after three sublots have been produced.
- D. **Test Methods.** Acceptance testing for compliance of asphalt content will use the Nuclear Asphalt Gauge Procedure; WSDOT Test Method 722-T. Acceptance testing for compliance of gradation will use the Quick Determination of Aggregate Gradation using Alternate Solvent Procedure; WSDOT Test Method 723-T.
- E. **Reject Mixture**
 - (1) **Rejection by Contractor.** The Contractor may, prior to sampling, elect to remove any defective material and replace it with new material at no expense to the Contracting Agency. Any such new material will be sampled, tested, and evaluated for acceptance.
 - (2) **Rejection Without Testing.** The Engineer may, without sampling, reject any batch, load, or section of roadway that appears defective in gradation or asphalt cement content. Material rejected before placement shall not be incorporated into the pavement. Any rejected section of roadway shall be removed.

No payment will be made for the rejected materials or the removal of the materials unless the Contractor requests that the rejected material be tested. If the contractor elects to have the rejected material tested, a minimum of three representative samples will be obtained and tested. Acceptance of rejected material will be based on conformance with the statistical acceptance specification. If the CPF for the rejected material is less than 0.75, no payment will be made for the rejected material, and in addition, the cost of sampling and testing shall be borne by the Contractor. However, if the CPF is greater than 0.75, the cost of sampling and testing will be borne by the Contracting Agency and the mix will be compensated at a CPF of 0.75. If rejection occurs after placement and the CPF is greater than 0.75, compensation for the rejected mix will be at a CPF of 0.75 with an addition of 10 percent of the unit contract price added for placement and removal costs.
 - (3) **A Partial Sublot.** In addition to the preceding random acceptance sampling and testing, the Engineer may also isolate from a normal subplot any material that is suspected of being defective in gradation or asphalt cement content. Such isolated material will not include an

original sample location. A minimum of three random samples of the suspect material will be obtained and tested. The material will then be evaluated for price adjustment in accordance with the statistical acceptance section. This material will be considered a separate lot. When the isolated material overlaps the division between materials sublots, the resulting two adjoining partial sublots will be combined into a single lot with a minimum of six random samples.

- (4) An Entire Sublot. If an entire sublot is rejected in accordance with Section 1-06.2, four additional random samples from this sublot will be obtained and the sublot evaluated as an independent lot with the original test result included as a fifth test with the new independent lot instead of with the original lot.
- (5) A Lot in Progress. The Contractor shall shut down operations and shall not resume asphalt concrete placement until such time as the engineer is satisfied that specification material can be produced whenever the Composite Pay Factor (CPF) for a lot in progress:
 - a. Drops below 1.00 and the Contractor is taking no corrective action, or
 - b. Is less than 0.75.
- (6) An Entire Lot. An entire lot with a CPF of less than 0.75 will be rejected. The designated percentage reduction as defined in Section 1-06.2(2)B under Financial Incentive Paragraph 1, Item 3, shall be 25 percent.

5-04.3(9) Spreading and Finishing

The mixture shall be laid upon an approved surface, spread, and struck off to the grade and elevation established. Asphalt pavers complying with Section 5-04.3(3) shall be used to distribute the mixture. Unless otherwise directed by the Engineer or specified in the Plans or in the Special Provisions, the nominal compacted depth of any layer of any course shall not exceed the following depths:

Asphalt Concrete Class E	0.35 foot
Asphalt Concrete Class A and B when used for Base Course	0.35 foot
Asphalt Concrete Class A, B, and F	0.25 foot
Asphalt Concrete Class G	0.10 foot
Asphalt Concrete Class D	0.08 foot

On areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impractical, the paving may be done with other equipment or by hand.

The placing of asphalt mixtures at night will not be permitted except by approval of the Engineer or if specified in the Special Provisions.

When the asphalt mixture is being produced by more than one asphalt plant, the material produced by each plant shall be placed by separate spreading and compacting equipment.

5-04.3(10) Compaction

5-04.3(10)A General

Immediately after the asphalt concrete mixture has been spread, struck off, and surface irregularities adjusted, it shall be thoroughly and uniformly compacted. The completed course shall be free from ridges, ruts, humps, depressions, objectionable marks, or irregularities and in conformance with the line, grade, and cross-section shown in the Plans or as established by the Engineer. If necessary, the mix design may be altered to achieve desired results.

Compaction shall take place when the mixture is in the proper condition so that no undue displacement, cracking, or shoving occurs. All compaction units shall be operated at the speed, within specification limits, that will produce the required compaction. Areas inaccessible to large compaction equipment shall be compacted by mechanical or hand tampers. Any asphalt concrete that becomes loose, broken, contaminated, shows an excess or deficiency of asphalt, or is in any way defective, shall be removed and replaced at no additional cost with fresh hot mix which shall be immediately compacted to conform with the surrounding area.

The type of rollers to be used and their relative position in the compaction sequence shall generally be the Contractor's option, provided specification densities are attained. An exception shall be that the pneumatic tired roller shall be used between October 1 and April 1. Coverages with a vibratory or steel wheel roller may precede pneumatic tired rolling. When asphalt concrete pavement Class D is being constructed, the use of pneumatic rollers will not be required.

Vibratory rollers shall not be operated in the vibratory mode when the internal temperature of the mix is less than 175 F without permission of the Chief Construction Engineer. In no case shall a vibratory roller be operated in a vibratory mode when checking or cracking of the mat occurs at a greater temperature. Vibratory rollers in the vibratory mode are also prohibited on bridge decks.

5-04.3(10)B Control

Asphalt concrete pavement Classes A, B, E, and F used in traffic lanes, including lanes for ramps, truck climbing, weaving, and speed change, and having a specified compacted course thickness greater than 0.10 foot, shall be compacted to a specified level of relative density. The specified level of relative density shall be a Composite Pay Factor (CPF) of not less than 1.00 when evaluated in accordance with Section 1-06.2(1), using a minimum of 91.0 percent of the reference maximum density as determined by WSDOT Test Method 705. The reference maximum density shall be determined as the moving average of the most recent five determinations for the lot of asphalt concrete being placed. The specified level of density attained will be determined by the statistical evaluation of five nuclear density gauge tests taken in accordance with WSDOT Test Method 715 on the day the mix is placed (after completion of the finish rolling) at randomly selected locations within each density lot. The quantity represented by each density lot will be no greater than a single day's production or approximately 400 tons, whichever is less. The Engineer will furnish the Contractor with a copy of the results of all acceptance testing performed in the field by 7:00 a.m. the morning of the next workday after testing, or for nighttime work within four hours after the beginning of the next paving shift. Acceptance of pavement compaction will be based on the statistical evaluation and CPF so determined.

For compaction lots falling below a 1.00 pay factor and thus subject to price reduction or rejection, cores may be used as an alternate to the nuclear density gauge tests. When cores are taken by the Contracting Agency at the request of the Contractor, they shall be requested by noon of the next workday after paving. The cost for the coring expenses when the core results indicate the specified level of relative density within a lot has not been achieved, will be deducted from any monies due or that may become due the Contractor under the contract at the rate of \$75 per core.

At the start of paving, if requested by the Contractor, a compaction test section shall be constructed, as directed by the Engineer, to determine the compactability of the mix design. Compactability shall be evaluated as the ability of the mix to attain a quality level corresponding to a pay factor of 1.00 or greater referenced to the specified minimum density (91 percent of the maximum density determined by WSDOT Test Method 705). If a compaction test section is requested, a pay factor of 1.00 shall apply until compactability is proven. Following determination of compactability, the Contractor is responsible for the control of the compaction effort. If the Contractor does not request a test section, the mix will be considered compactible.

Asphalt Concrete Classes A, B, E, F, and G constructed under conditions other than listed above shall be compacted on the basis of a test point evaluation of the compaction train. The test point evaluation shall be performed in accordance with instructions from the Engineer. The number of passes with an approved compaction train, required to attain the maximum test point density, shall be used on all subsequent paving.

Asphalt Concrete Class D and preleveling mix shall be compacted to the satisfaction of the Engineer.

In addition to the randomly selected locations for tests of the density, the Engineer may also isolate from a normal lot any area that is suspected of being defective in relative density. Such isolated material will not include an original sample location. A minimum of 5 randomly located density tests will be taken. The isolated area will then be evaluated for price adjustment in accordance with the statistical acceptance section, considering it as a separate lot.

5-04.3(11) Joints

The placing of the top or wearing course shall be as nearly continuous as possible, and the roller shall pass over the unprotected end of the freshly laid mixture only when the laying of the course is discontinued for such length of time as to permit the mixture to become chilled. When the work is resumed, the previously compacted mixture shall be cut back to produce a slightly beveled edge for the full thickness of the course.

Where a transverse joint is being made in the wearing course, strips of heavy wrapping paper shall be used. The wrapping paper shall be removed and the joint trimmed to a slightly beveled edge for the full thickness of the course prior to resumption of paving.

The material which is cut away shall be wasted and new mix shall be laid against the fresh cut. Rollers or tamping irons shall be used to seal the joint.

Where the asphalt concrete is placed against a concrete or stone curb or gutter, against a cold pavement joint, or any metal surface, a thin paint coat of emulsified asphalt shall be applied in advance. The application shall be thin and uniform, care being exercised to avoid accumulation of asphalt in depressions.

The longitudinal joint in any one layer shall be offset from the layer immediately below by not more than 6 inches nor less than 2 inches. All longitudinal joints constructed in the top layer shall be at a lane line or edge line of the traveled way. However, on one-lane ramps a longitudinal joint may be constructed at the center of the traffic lane, subject to approval by the Engineer, if:

1. The ramp must remain open to traffic, or
2. The ramp is closed to traffic and a hot-lap joint is constructed.

If a hot-lap joint is allowed, two paving machines shall be used; a minimum compacted density in accordance with Section 5-04.3(10)B shall be achieved throughout the traffic lane; and construction equipment shall not impact any uncompacted mix.

When asphalt concrete pavement is placed adjacent to cement concrete pavement, the Contractor shall construct longitudinal joints between the asphalt concrete pavement and the cement concrete pavement. The joint shall be sawed to the dimensions shown on the Standard Plan and filled with material meeting the requirements of Section 9-04.2.

5-04.3(12) Samples

The Engineer reserves the right to have samples cut or cored from the completed pavement or the individual courses. Additionally, the Engineer may take samples of the uncompressed asphalt concrete mixtures as well as all materials incorporated in the work. Where samples have been taken from the uncompressed asphalt concrete, new material shall be placed and compacted to conform with the surrounding area at no additional expense to the Contracting Agency.

5-04.3(13) Surface Smoothness

The completed surface of all courses shall be of uniform texture, smooth, uniform as to crown and grade, and free from defects of all kinds. The completed surface of the wearing course shall not vary more than $\frac{1}{8}$ inch from the lower edge of a 10-foot straightedge placed on the surface parallel to the centerline. The transverse slope of the completed surface of the wearing course shall vary not more than $\frac{1}{4}$ inch in 10 feet from the rate of transverse slope shown in the Plans.

When deviations in excess of the above tolerances are found, the pavement surface shall be corrected by the addition of asphalt concrete mixture of an appropriate class to low places or the removal of material from high places by grinding with an approved grinding machine or by removal and replacement of the wearing course of asphalt concrete. Correction of defects shall be carried out until there are no deviations anywhere greater than the allowable tolerances.

All areas in which the surface of the completed pavement deviates more than twice the allowable tolerances described above shall be removed and replaced to the satisfaction of the Engineer.

However, if deviations are found which exceed the allowable tolerances but are not in excess of twice the allowable tolerances described above, and, in the opinion of the Engineer, correction by means of any of the methods specified above will not produce satisfactory results as to smoothness and serviceability, the Engineer may accept the completed pavement and shall deduct from monies due or that may become due to the Contractor the sum of \$500.00 for each and every section of single traffic lane 100 feet in length in which any deviations as described above are found. Under the circumstances described above, the decision whether to accept the completed pavement or to require corrections as described above shall be vested entirely in the Engineer.

All costs involved in making the corrections of defects described above shall be borne by the Contractor and no compensation will be made for this work.

When Portland cement concrete pavement is placed on asphalt concrete pavement, the surface tolerance of the asphalt concrete pavement shall be such that no elevation lies above the plan grade minus the specified plan depth of Portland cement concrete pavement. Prior to placing the Portland cement concrete pavement, any such irregularities shall be brought to the required tolerance by grinding or other means approved by the Engineer, at no expense to the Contracting Agency.

When utility appurtenances such as manhole covers and valve boxes are located in the traveled way, the roadway shall be paved before the utility appurtenances are adjusted to the finished grade.

5-04.3(14) Planing Bituminous Pavement

The planing shall be performed with a milling machine of a type that has operated successfully on work comparable with that to be done under the contract and shall be approved by the Engineer prior to use.

The surface of existing pavements or the top surface of subsurface courses shall be planed to remove irregularities and to produce a smooth surface.

Planing shall be performed in a manner such that the underlying pavement is not torn, broken, or otherwise injured by the planing operation. The surface of the underlying pavement shall be slightly grooved or roughened sufficiently to ensure a bond when overlaid.

The Contractor shall keep the planings and remove them from the project, or stockpile the planings on Contracting Agency Property, if a site is shown in the Plans, for future use by the Contracting Agency. If the Planings are not to be stockpiled for the Contracting Agency's use, the Contractor may utilize the planings in the asphalt concrete pavement as specified in Section 5-04.2. All other debris resulting from the planing operations shall be disposed of by the Contractor to the satisfaction of the Engineer. Unless otherwise provided, the Contractor shall provide a waste site for the disposal of these materials.

For mainline planing operations, the equipment shall have automatic controls, with sensors for either or both sides of the equipment, capable of sensing the proper grade from an outside reference line, or multi-footed ski-like arrangement. The automatic controls shall also be capable of maintaining the desired transverse slope. The transverse slope controller shall be capable of maintaining the screed at the desired slope within plus or minus 0.1 percent.

5-04.3(15) Asphalt Concrete Approach

Asphalt approaches shall be constructed at the locations shown in the Plans or as directed by the Engineer in accordance with this section.

5-04.3(16) Weather Limitations

Asphalt concrete pavement for wearing course shall not be placed on any traveled way after October 15 without written approval from the District Administrator.

Asphalt for prime coat shall not be applied when the ground temperature is lower than 50 F, without written permission of the Engineer.

Asphalt concrete Class D shall not be placed when the air temperature is less than 60 F.

Asphalt concrete shall not be placed on any wet surface, or when the average surface temperatures are less than those specified in the following table, or when weather conditions otherwise prevent the proper handling or finishing of the bituminous mixtures:

Compacted Thickness (Feet)	Surface Temperature Limitations	
	Surface Course	Sub-Surface Courses
Less than 0.10	55 F	55 F
0.10 to 0.20	45 F	35 F
0.21 to 0.35	35 F	35 F
More than 0.35	DNA	25 F*

*Only on dry subgrade, not frozen and when air temperature is rising.

5-04.3(17) Paving Under Traffic

When the roadway being paved is open to traffic, the following requirements shall apply:

The Contractor shall keep on-ramps and off-ramps open to traffic at all times except when paving the ramp or paving across the ramp. During such time, the ramp may be closed for the minimum time required to place and compact the mixture provided there is advance warning of the ramp closure. In hot weather, the Engineer may require the application of water to the pavement to accelerate the finish rolling of the pavement and to shorten the time required before reopening to traffic.

Before closing a ramp, advance warning signs shall be placed and the detour or alternate route signed. Ramps shall not be closed on consecutive interchanges at the same time.

During paving operations, temporary pavement markings shall be maintained throughout the project. Temporary pavement markings shall be installed on the roadway that was paved that day. Temporary pavement markings shall be in accordance with Section 8-23.

All costs in connection with performing the work in accordance with these requirements, except the cost of temporary pavement markings, shall be included in the unit contract prices for the various bid items involved in the contract.

5-04.3(18) Change in Grade of Asphalt

If the Engineer orders a change in grade of paving asphalt, any additional compensation will be limited to the actual additional cost of the asphalt based on invoices from the supplier. If the cost of the substituted paving asphalt is lower, the difference in the cost and that of the original material specified, based on invoices from the supplier, shall be deducted from monies due the Contractor.

5-04.3(19) Sealing of Driving Surfaces

Any wearing course or other pavement course to be used for the driving surface will be evaluated by the Engineer to determine whether a fog seal is required. When the results of nuclear or core density testing show that a seal is needed, or when the surface course is asphalt concrete Class D, the Contractor shall apply a fog seal of CSS-1 at the rate 0.05 to 0.10 (0.03 to 0.05 residual) gallons per square yard. Unless otherwise approved by the Engineer, fog seal shall be applied prior to opening to traffic. Material used for fog seal will be measured and paid for as asphalt for tack coat.

5-04.3(20) Anti-Stripping Additive

When directed by the Engineer, an anti-stripping additive shall be added to the asphalt material in accordance with Section 9-02.4.

5-04.3(21) Paving Asphalt Revision

Should the amount of new paving asphalt and recycling agent, if any, required by the job mix formula for a lot of asphalt concrete produced with aggregate from a Contracting Agency provided source vary by more than plus or minus 0.3 percent from the amount shown in the Special Provisions, an adjustment in payment will be made. The adjustment in payment (plus or minus) will be based on the invoice cost to the Contractor FOB at the project site. A new contract item, Paving Asphalt Revision, will be established for material varying from the Special Provision, Asphalt Content, by more than plus or minus 0.3 percent. No adjustment will be made when the Contractor elects not to use a Contracting Agency provided source, or when no source is made available by the Contracting Agency.

The new paving asphalt and recycling agent revision will be measured by the ton with the quantity determined from the stated value, the job mix formula, and the asphalt concrete quantity in the lot in tons.

5-04.4 Measurement

Preparation of untreated roadway will be measured by the mile once along the centerline of the main line roadway. This measurement will include all main line roadways, ramps, auxiliary lanes, service roads, frontage roads, and any necessary shoulders. Measurement will be to the nearest 0.01 mile.

Asphalt for prime coat will be measured by the ton in accordance with Section 1-09.

Prime coat aggregate will be measured by the cubic yard, truck measure, or by the ton, whichever is designated in the proposal.

Asphalt for tack coat will be measured by the ton, before dilution, in accordance with Section 1-09.

Asphalt concrete pavement, asphalt concrete approach, asphalt concrete for pavement repair, and asphalt concrete for preleveling will be measured by the ton with no deduction being made for the weight of liquid asphalt, blending sand, mineral filler, or any other component of the mixture.

Paving asphalt AR-4000W will be measured by the ton with the quantity determined from production data. The Contracting Agency reserves the right to make random checks of the gross and tare weights of the transport equipment at the time of delivery as well as measuring the asphalt volume in the storage tank prior to and after the deposit from the transport vehicle.

On continuous mix or rotary drum plants, the asphalt may be measured by deposits and withdrawals from storage tanks located explicitly for the project or from data obtained from the asphalt material feed as described in Section 5-04.3(1)D.

The decision as to method of measurement of asphalt will rest with the Contracting Agency. In no event will measurement be for more than the amount delivered to the job site as evidenced by the Notice of Asphalt Shipment.

Blending sand will be measured by the cubic yard in trucks at the plant.

Water will be measured and paid by the M gallon as provided in Section 2-07.

Planing bituminous pavement will be measured by the square yard.

Soil residual herbicide will be measured by the mile for the stated width to the nearest .01 mile or by the square yard, whichever is designated in the proposal.

Longitudinal joint seals between the asphalt concrete pavement and cement concrete pavement will be measured by the linear foot along the line and slope of the completed joint seal.

Pavement repair excavation will be measured by the square yard in place prior to excavation.

5-04.5 Payment

Payment will be made in accordance with Section 1-04.1, for each of the following bid items that are included in the proposal:

"Preparation of Untreated Roadway", per mile.

The unit contract price per mile for "Preparation Of Untreated Roadway" shall be full pay for all work described under Section 5-04.3(5)B, with the exception, however, that all costs involved in patching the roadway prior to placement of asphalt concrete shall be included in the unit contract price per ton for "Asphalt Conc. Pavement Cl. ____" which was used for patching. If the proposal does not include a bid item for "Preparation of Untreated Roadway", the roadway shall be prepared as specified, but the work shall be included in the contract prices of the other items of work.

"Asphalt (grade)", per ton.

"Prime Coat Agg.", per cubic yard, or per ton.

The unit contract price per cubic yard or per ton for "Prime Coat Agg." shall be full pay for furnishing, loading, and hauling aggregate to the place of deposit and spreading the aggregate in the quantities required by the Engineer.

"Asphalt for Tack Coat", per ton.

The unit contract price per ton for "Asphalt for Tack Coat" shall be full pay for all costs of material, labor, tools, and equipment necessary for the application of the tack coat as specified. If there is no bid item and a tack coat is required, it shall be applied and the work shall be included in the unit contract prices of the other items of work.

"Asphalt Conc. Pavement Cl. ____", per ton.

"Asphalt Conc. Approach Cl. ____", per ton.

"Asphalt Conc. for Preleveling Cl. ____", per ton.

The unit contract price per ton for "Asphalt Conc. Pavement Cl. ____", "Asphalt Conc. Approach Cl. ____", and "Asphalt Conc. for Preleveling Cl. ____" shall be full pay for construction of each class of asphalt concrete pavement and approach, including the preparation of any existing Portland cement concrete, brick or bituminous surface, or pavement base.

If the Contractor is required to furnish the aggregates, all costs of furnishing, hauling and processing aggregates and blending sand into the complete mix shall be included in the unit contract price per ton for asphalt concrete pavement of the class specified, except that blending sand, when set up as a bid item, will be paid for in the manner described below. At the discretion of the Engineer, the Contractor may be required to include mineral filler in the mix.

If any of the aggregates are furnished in stockpile by the Contracting Agency, the cost of hauling and incorporating those aggregates in the mix, and all costs of furnishing, hauling, and incorporating the necessary blending sand and any additional aggregates into the complete mix shall be included in the unit contract price per ton for asphalt concrete

pavement of the class specified, except that when blending sand is set up as a bid item, it will be paid for in the manner described below. At the discretion of the Engineer, the Contractor may be required to include mineral filler in the mix.

"Asphalt Conc. for Pavement Repair", per ton.

All costs for tack coat shall be included in the unit contract price for "Asphalt Conc. for Pavement Repair".

"Pavement Repair Excavation Incl. Haul", per square yard.

"Blending Sand", per cubic yard.

If there is a bid item for blending sand and the Contractor elects to provide aggregates from a source other than that provided by the Contracting Agency, and if it becomes necessary, in the opinion of the Engineer, to use blending sand for proper grading of the aggregates, the Contractor shall furnish and incorporate sufficient quantities of blending sand to meet the requirements as determined by the Engineer. The pay quantity will be the amount actually used, but not exceeding the quantity set up in the contract. If there is no bid item for blending sand, whatever amount of blending sand as may be needed to meet the requirements as determined by the Engineer, shall be furnished by the Contractor at no expense to the Contracting Agency.

"Mineral Filler", by force account.

"Mineral Filler", if required, will be paid for by force account as specified in Section 1-09.6. For the purpose of providing a common proposal for all bidders, the Contracting Agency has entered an amount in the proposal to become a part of the total bid by the Contractor.

"Planing Bituminous Pavement", per square yard.

"Anti-Stripping Additive", by force account.

"Anti-Stripping Additive" will be paid for in accordance with Section 1-09.6 except that no overhead, profit or other costs shall be allowed. Payment shall be made only for the invoice cost of the additive. The quantity of asphalt material shall not be reduced by the quantity of anti-stripping additive used. For the purpose of providing a common proposal for all bidders, the Contracting Agency has entered an amount in the proposal to become a part of the total bid by the Contractor.

"Crack Sealing", by force account.

"Crack Sealing" will be paid for by force account as specified in Section 1-09.6. For the purpose of providing a common proposal for all bidders, the Contracting Agency has entered an amount in the proposal to become a part of the total bid by the Contractor.

"Soil Residual Herbicide ____ ft. Wide," per mile.

"Soil Residual Herbicide", per square yard.

"Longitudinal Joint Seal", per linear foot.

"Job Mix Compliance Price Adjustment," by calculation.

Job Mix Compliance Price Adjustment" will be calculated and paid for as described in Section 5-04.5(1)A.

"Compaction Price Adjustment," by calculation.

"Compaction Price Adjustment" will be calculated and paid for as described in Section 5-04.5(1)B.

5-04.5(1) Quality Assurance Price Adjustments

All asphalt concrete pavement will be subject to price adjustments for Quality of AC Mix and Quality of AC Compaction based on the Acceptance Plans in effect for each class of ACP within the contract. For the purpose of providing a common proposal for all bidders, the Contracting Agency has estimated a calculated amount for all price adjustment items and has entered these amounts in the proposal to become a part of the total bid by the Contractor. Conditions (1) and (2) of the first paragraph of Section 1-04.6 do not apply to these items, and any impact due to an increase or decrease from plan quantities for these items will be the sole risk of the Contractor.

5-04.5(1)A Price Adjustments for Quality of AC Mix

Statistical analysis of quality of gradation and asphalt content will be determined based on Section 1-06.2 using the following price adjustment factors:

Table of Price Adjustment Factors

Constituent	Factor "F"
All aggregate passing 1", 3/4", 5/8", 1/2", and 3/8" sieves	2
All aggregate passing 1/4" sieve	6
All aggregate passing No. 10 sieve	10
All aggregate passing No. 40 sieve	6
All aggregate passing No. 200 sieve	20
Asphalt cement	52

Factors for Open Graded Mix

Constituent	Factor "F"
All aggregate passing 1/2" sieve	10
All aggregate passing 3/8" sieve	15
All aggregate passing No. 4 sieve	40
All aggregate passing No. 8 sieve	15
All aggregate passing No. 200 sieve	20

Note: Open graded mix shall be evaluated for gradation only. The quality incentive multiplier for open-graded mix shall be 40 percent rather than 60.

If a constituent is not measured in accordance with these Specifications, its individual pay factor will be considered 1.00 in calculating the Composite Pay Factor (CPF).

1. Statistical Acceptance. For each lot of asphalt concrete pavement produced under Statistical Acceptance, a Job Mix Compliance Incentive Factor (JMCIF) will be determined. The JMCIF equals the difference between the CPF and unity with regard to sign multiplied by 60 percent. The Job Mix Compliance Price Adjustment will be calculated as the product of the JMCIF, the quantity of asphalt concrete in the lot in tons, and the unit contract price per ton of mix.
2. Nonstatistical Acceptance. Each lot of asphalt concrete pavement produced under Nonstatistical Acceptance and having all constituents falling within the limits of the job mix formula shall be accepted at the unit contract price with no further statistical evaluation. When one or more constituents fall outside the job mix formula, the lot shall be evaluated to determine the appropriate CPF. When

less than three sublots exist, backup samples of the existing sublots or samples from the street shall be tested to provide a minimum of three sets of results for evaluation.

For each lot of asphalt concrete pavement produced under Nonstatistical Acceptance when the calculated CPF is less than 1.00, a Nonconforming Mix Factor (NCMF) will be determined. The NCMF equals the difference between the CPF and unity with regard to sign multiplied by 60 percent. The Job Mix Compliance Price Adjustment will be calculated as the product of the NCMF, the quantity of asphalt concrete in the lot in tons, and the unit contract price per ton of mix.

5-04.5(1)B Price Adjustments for Quality AC Compaction

For each compaction control lot, a Compaction Incentive Price Adjustment Factor (CIPAF) will be determined. The CIPAF equals the difference between the Composite Pay Factor and unity with regard to sign multiplied by 40 percent. The Compaction Compliance Price Adjustment will be calculated as the product of CIPAF, the quantity of asphalt concrete in the compaction control lot in tons, and the unit contract price per ton of mix.

5-05 CEMENT CONCRETE PAVEMENT**5-05.1 Description**

This work shall consist of constructing a pavement composed of Portland cement concrete on a prepared subgrade or base in accordance with these Specifications and in conformity with the lines, grades, thicknesses, and typical cross-sections shown in the Plans or established by the Engineer.

5-05.2 Materials

Materials shall meet the requirements of the following sections:

Portland Cement	9-01
Fine Aggregate	9-03
Coarse Aggregate	9-03
Joint Filler	9-04.1
Joint Sealants	9-04.2
Reinforcing Steel	9-07
Dowel Bars	9-07.5
Tie Bars	9-07.6
Curing Materials and Admixtures	9-23
Water	9-25
Epoxy Resins	9-26

5-05.3 Construction Requirements**5-05.3(1) Proportioning Materials**

Concrete for pavement shall be classified according to the age at which the pavement is designed to be put into use. The standard paving mix is 14-day. The amount of cement (cement factor) for a cubic yard of concrete for each design age shall be not less than designated in the table. Note: the cement factor is defined as the amount of cement per cubic yard of mix, determined in accordance with WSDOT Test Method No. 806.

Concrete shall be air entrained by the use of an approved air entraining admixture to provide an air content in the plastic concrete on the roadway in front of the spreader or slip-form paver of not less than 4½ percent, nor more than 6½ percent as determined in accordance with WSDOT Test Method No. 805.

The Plans will show the design age and the standard paving section. The standard paving section is defined as that thickness of pavement that would be used with the standard 14-day paving mix. In cases where the design age is less than 14 days, the Plans will also show the thickness used by the Engineer for design purposes. Where design ages of less than 14 days are shown in the Plans or ordered by the Engineer, the table below gives alternate mixes involving the use of different types or amounts of cement, or increased thickness over the standard section, or both. The Contractor will have the option of selecting from this table an alternate mix and thickness to use for the specified design age.

Concrete Mixes for Pavements

Design Age	Pavement Thickness Increase Over Standard Section	Portland Cement Type	Proportions: Amounts in Pounds Per Cubic Yard				Flexural Design Strength
	Cement Factor		Aggregates Fine	No. 4	No. 5		
14-day	0.00'	I or II	565	1230	1030	1030	650
10-day	0.04'	I or II	565	1230	1030	1030	590
7-day	0.00'	I or II	625	1145	1030	1030	650
	0.08'	I or II	565	1230	1030	1030	540
	0.04'	I or II	625	1145	1030	1030	590
	0.00'	I or II	750	975	1030	1030	650
	0.00'	III	565	1230	1030	1030	650
5-day	0.08'	I or II	655	1100	1030	1030	540
4-day	0.08'	III	565	1230	1030	1030	540
	0.08'	I or II	750	975	1030	1030	540
	0.08'	III	655	1100	1030	1030	540
3-day	0.12'	I or II	750	975	1030	1030	500
	0.12'	III	655	1100	1030	1030	500

Paving mix produced from dedicated plants shall use cement from a single mill source for the duration of a paving season.

The exact proportions of the mix will be determined by the Engineer to produce a mix with the specified amount of cement.

The weights shown in the table above for fine and coarse aggregates are based on assumed bulk specific gravities for each of 2.67. In case the bulk specific gravity of any size aggregate differs from this value, the weights shall be adjusted in proportion. Correction of the weights shall also be made for the quantity of water in excess of the saturated surface dry condition by the aggregate at the time of weighing.

The Contractor may, with the approval of the Engineer, blend the coarse aggregate from sizes other than the sizes given in the table above provided that:

- The resulting coarse aggregate meets all requirements of Section 9-03.1(3)C, Grading No. 2,
- Not less than 25 percent of the blend is from any size, and
- Gradings for the proposed sizes and their proportions in the blend are furnished to the Engineer before production of the aggregate, except from commercial sources, in which case this information must be submitted and approved before proportioning and mixing the concrete for this project.

Fine aggregate shall conform to Section 9-03.1(2) Class 1.

When no provision is made in the Contract for payment for alternate design ages, payment for additional costs to the Contractor for the alternate design ages ordered by the Engineer will be based on invoice differential for Type III or the additional Type I or Type II cement used. The additional thickness of pavement required will be paid at the rate determined by dividing the unit bid price per square yard for the pavement in question by the original plan thickness in hundreds of a foot for each 0.01 foot of additional thickness, which price shall be full payment for the extra excavation and concrete required for

constructing the increased depth of pavement. Alternate design age pavements constructed by the Contractor, for the Contractor's convenience, shall be at no additional cost to the Contracting Agency.

Unfinished cement concrete pavement shall be the standard 14-day design age mix except the asphalt concrete overlay may be constructed after 7 days of curing. The pavement may be opened to traffic upon completion of the construction of the asphalt pavement; otherwise, the Contractor shall protect the unfinished concrete pavement from traffic for the full 14 days.

5-05.3(1)A Alternate Concrete Mix Design for Paving

The Contractor may provide a concrete mix design as an alternate to the standard mixes of Section 5-05.3(1). Concrete placability and workability shall be the responsibility of the Contractor. Following approval of the Contractor's proposal, all other requirements of Section 5-05 shall apply.

1. **Materials.** Materials shall conform to Section 5-05.2. Fine aggregate shall conform to Section 9-03.1(2), Class 1. Coarse aggregate shall conform to Section 9-03.1(4) and shall be either grading No. 467 of Section 9-03.1(4)C or grading No. 2 of Section 9-03.1(3)C. Fly ash, if used, shall conform to Section 9-23.9 and shall be limited to Class F with a maximum CaO content of 15 percent by weight. The fly ash shall be limited to 20 percent by weight, of the total cementitious material. As an alternative to the use of fly ash and cement as separate components, a blended hydraulic cement may be used. Blended hydraulic cement shall conform to ASTM C595 Type IP(MS).

In making calculations relative to cement factor or allowable water/cement ratio, the total cementitious material shall be taken as the weight of Portland cement plus the weight of fly ash.

2. **Submittals.** The Contractor's submittal for approval shall include the mix proportions per cubic yard and the proposed sources for all ingredients including the power plant that generated the fly ash. The mix shall be capable of providing a minimum flexural strength of 650 psi at the specified design age: (normally 14 days) for standard thickness. For increased thickness alternates, the design strength requirement may be proportionally reduced. Evaluation of strength shall be based on statistically analyzed results of 5 beam specimens and demonstrate a quality level of not less than 80 percent analyzed in accordance with Section 1-06.2(2)D.

Mix designs submitted by the Contractor shall provide a unique identification for each proposal and shall include test data confirming that concrete made in accordance with the proposed design will meet the requirements of these specifications. Test data shall be from an independent testing lab or from a commercial concrete producer's lab. If the test data is developed at a producer's lab, the Engineer or a representative may witness all testing.

3. **Mix Design Modifications.** The Contractor may initiate minor adjustments to the approved mix proportions. A plus or minus 100-pound variation in both the coarse and fine aggregate target weights will be allowed from the approved Contractor provided mix design weights as a modification without resubmittal. The Contractor shall notify the Engineer in writing of any such proposed modification.

5-05.3(2) Consistency

The materials shall be mixed with sufficient water to produce a stiff concrete which will hold its shape when deposited upon the subgrade. Concrete placed during wet weather must be mixed with sufficient water to produce a very stiff mixture. The consistency shall be such that separation of the mortar from the coarse aggregate will not occur in handling.

The water/cementitious material ratio, by weight, shall not exceed 0.44. When slip form paving equipment is used, the Contractor shall further control concrete consistency to ensure that edge slump conforms to the requirements of Section 5-05.3(11).

5-05.3(3) Equipment

Equipment necessary for handling materials and performing all parts of the work shall be approved by the Engineer as to design, capacity, and mechanical condition. The equipment shall be at the jobsite sufficiently ahead of the start of paving operations to be examined thoroughly and approved.

1. Batching Plant and Equipment

- a. General. The batching plant shall include bins, weighing hoppers, and scales for the fine aggregate and for each size of coarse aggregate. If cement is used in bulk, a bin, hopper, and separate scale for cement shall be included. The weighing hoppers shall be properly sealed and vented to preclude dusting during operation. The batching plant shall be equipped with a suitable nonresettable batch counter which will correctly indicate the number of batches proportioned.
- b. Bins and hoppers. Bins with adequate separate compartments for fine aggregate and for each size of the coarse aggregate shall be provided in the batching plant.
- c. Scales. Plant and truck scales shall meet the requirements of Section 1-09.2.
- d. The batching plant shall be equipped to proportion aggregates and bulk cement by means of automatic weighing devices of an approved type.

2. Mixers

- a. General. Concrete may be mixed at a batching plant or wholly or in part in truck mixers. Each mixer shall have attached in a prominent place a manufacturer's plate showing the capacity of the drum in terms of volume of mixed concrete and the speed of rotation of the mixing drum or blades.
- b. Batching plant. Mixing shall be in an approved mixer capable of combining the aggregates, cement, and water into a thoroughly mixed and uniform mass within the specified mixing period. The mixer shall be equipped with an approved timing device which will automatically lock the discharge lever when the drum has been charged and release it at the end of the mixing period. The device shall be equipped with a bell or other suitable warning device adjusted to give a clearly audible signal each time the lock is released.

Mixers shall be cleaned at suitable intervals. The pickup and throw-over blades in the drum shall be repaired or replaced when they are worn down $\frac{3}{4}$ inch or more. The Contractor shall have available at the jobsite a copy of the manufacturer's design, showing dimensions and arrangements of the blades in reference to original height and depth, or provide permanent

marks on blades to show points of $\frac{3}{4}$ inch wear from new conditions. Drilled holes $\frac{1}{4}$ inch in diameter near each end and at midpoint of each blade are recommended.

- c. Truck mixers and truck agitators. Truck mixers used for mixing and hauling concrete, and truck agitators used for hauling plant-mixed concrete, shall conform to the requirements of Section 6-02.3(4)A.
 - d. Nonagitator trucks. Bodies of nonagitator hauling equipment for concrete shall be smooth, mortar-tight, metal containers and shall be capable of discharging the concrete at a satisfactory controlled rate without segregation. If discharge of concrete is accomplished by tilting the body, the surface of the load shall be retarded by a suitable baffle. Covers shall be provided when needed for protection. Plant-mixed concrete may be transported in nonagitator vehicles provided that the concrete is delivered to the site of the work and discharge is completed within 45 minutes after the introduction of mixing water to the cement and aggregates, and provided the concrete is in a workable condition when placed.
- 3. Finishing Equipment. The standard method of constructing concrete pavement on state highways shall be with approved slip-form paving equipment designed to spread, consolidate, screed, and float-finish the freshly placed concrete in one complete pass of the machine so a dense and homogeneous pavement is achieved with a minimum of hand finishing. On other roads and on WSDOT projects requiring less than 500 square yards of cement concrete pavement or requiring individual placement areas of less than 500 square yards, irregular areas, and at locations inaccessible to slip-form paving equipment, cement concrete pavement may be placed with approved placement and finishing equipment utilizing stationary side forms. Hand screeding and float finishing of cement concrete pavement may only be utilized on small irregular areas as allowed by the Engineer.
 - 4. Joint Sawing Equipment. The Contractor shall provide approved power driven concrete saws for sawing joints, adequate in number of units and power to complete the sawing at the required rate. The Contractor shall provide at least one standby saw in good working order. An ample supply of saw blades shall be maintained at the site of the work at all times during sawing operations. The Contractor shall provide adequate artificial lighting facilities for night sawing. All of this equipment shall be on the job both before and continuously during concrete placement. Sawing equipment shall be available immediately and continuously upon call by the Engineer on a 24 hour basis, including Saturdays, Sundays and holidays.
 - 5. Smoothness Testing Equipment. The Contractor shall provide a California-type computerized profilograph, complete with recorder, for determining the profile index of the pavement according to WSDOT Test Method No. 807.

The profilograph shall be on the project, calibrated, in good working condition, and ready for operation before construction of any concrete pavement begins. The operator shall be competent and experienced in operation of the equipment.

5-05.3(4) Handling, Measuring, and Batching Materials

The batch plant site, layout, equipment, and provisions for transporting material shall ensure a continuous supply of material to the work.

1. Measuring Materials

- a. **Aggregates.** The fine aggregate and each size of coarse aggregate shall be measured by weighing, the weight for the particular aggregates used being proportional to their respective bulk specific gravities. The weighing of each size of material shall be a separate and distinct operation.

Corrections shall be made for variations in weight of materials due to the moisture content.

The equipment for weighing aggregates shall conform to the requirements of Section 1-09.2.

- b. **Cement:** Cement shall be weighed on scales meeting the requirements of Section 1-09.2. Adequate provision shall be made to prevent loss of cement between the batch box and the mixer.
 - c. **Water:** Water may be measured either by volume or by weight. The accuracy of measuring the water shall be within a range of error of not over 1 percent.
- 2. **Batching Materials.** On all projects requiring more than 2500 cubic yards of Portland cement concrete for paving, the batching plant shall be equipped to proportion aggregates and cement by weight by means of automatic and interlocked proportioning devices of approved type.
 - 3. **Acceptance of Concrete.** The concrete producer shall provide a certificate of compliance for each truckload of concrete in accordance with Section 6-02.3(5).

5-05.3(5) Mixing Concrete

The concrete may be mixed in a batching plant or in truck mixers. The mixer shall be of an approved type and capacity. Mixing time shall be measured from the time all materials are in the drum. Ready-mixed concrete shall be mixed and delivered in accordance with the requirements of Section 6-02.3(4), 6-02.3(4)A, 6-02.3(4)B, and 6-02.3(4)D.

When mixed in a batching plant, the mixing time shall not be less than 50 seconds nor more than 90 seconds.

The mixer shall be operated at a drum speed as shown on the manufacturer's name plate on the mixer. Any concrete mixed less than the specified time shall be discarded and disposed of by the Contractor at no expense to the Contracting Agency. The volume of concrete mixed per batch shall not exceed the mixer's nominal capacity in cubic yards, as shown on the manufacturer's standard rating plate on the mixer.

Each concrete mixing machine shall be equipped with a device for counting automatically the number of batches mixed during the day's operation.

All elements of a batch shall be simultaneously and continuously fed to the mixer to ensure uniform distribution of cement, water, aggregates, and admixtures.

Retempering concrete by adding water or by other means will not be permitted. Admixtures for increasing the workability or for accelerating the set will be permitted only when specified or approved by the Engineer.

5-05.3(5)A Limitations of Mixing

Concrete shall not be mixed, placed, or finished when the natural light is inadequate, as determined by the Engineer, unless an adequate and approved artificial lighting system is operated.

Mixing and placing concrete shall be discontinued when a descending air temperature in the shade away from artificial heat reaches 40 F and shall not be resumed until an ascending air temperature in the shade and away from artificial heat reaches 35 F unless authorized in writing by the Engineer.

When mixing and placing is authorized during cold weather, the aggregates may be heated by either steam or dry heat prior to being placed in the mixer. The apparatus used shall heat the mass uniformly and shall be arranged to preclude the possible occurrence of overheated areas which might injure the materials. Unless otherwise authorized, the temperature of the mixed concrete shall be not less than 50 F and not more than 90 F at the time of discharge into the hauling conveyance. No concrete shall be mixed with frozen aggregates.

5-05.3(6) Subgrade

The subgrade shall be constructed in accordance with Section 2-06.

The subgrade shall be prepared and compacted a sufficient distance beyond each edge of the area which is to receive concrete pavement in order to accommodate the slip-form equipment without visible distortion. Concrete shall not be placed on a frozen subgrade nor during heavy rainfall.

The subgrade shall be thoroughly saturated with water before the concrete is to be placed and shall be wet for a depth of at least 8 inches and for such additional depth as may be required to prevent hair-checking in the concrete.

When the subgrade is an asphalt or concrete treated base the surface shall be clean and free of any deleterious materials. Immediately prior to placing concrete on a treated base, the surface of the base shall be uniformly moist. Any excess water standing in pools or flowing on the surface shall be removed prior to placing concrete.

5-05.3(7) Placing, Spreading, and Compacting Concrete

All of the requirements for concrete mix, density, finish, and surface smoothness apply, regardless of the methods used to place the pavement.

5-05.3(7)A Slip-Form Construction

The concrete shall be distributed uniformly into final position by the slip-form paver without delay. The alignment and elevation of the paver shall be regulated from outside reference lines established for this purpose. The paver shall vibrate the concrete for the full width and depth of the strip of pavement being placed and the vibration shall be adequate to provide a consistency of concrete that will stand normal to the surface with sharp well defined edges. The sliding forms shall be rigidly held together laterally to prevent spreading of the forms.

The plastic concrete shall be effectively consolidated by internal vibration with transverse vibrating units for the full width of pavement and/or a series of equally spaced longitudinal vibrating units. The space from the outer edge of the pavement to the outer longitudinal unit shall not exceed 9 inches. The spacing of internal units shall be uniform and not exceed 18 inches.

The term internal vibration means vibration by vibrating units located within the specified thickness of pavement section and a minimum distance equal to the pavement thickness ahead of the screed.

The rate of vibration of each vibrating unit shall be not less than 7,500 vibrations per minute, and the amplitude of vibration shall be sufficient to be perceptible on the surface of the concrete along the entire length of the vibrating unit and for a distance of at least 1 foot. The frequency of vibration or amplitude shall be varied proportionately with the rate of travel to result in a uniform density and air content. The paving machine shall be equipped with a tachometer or other suitable device for measuring and indicating the actual frequency of vibrations.

The provisions relating to the frequency and amplitude of internal vibration shall be considered the minimum requirements and are intended to ensure adequate density in the hardened concrete. Referee testing of hardened concrete will be performed by cutting cores from the finished pavement after a minimum of 24 hours of curing when, in the opinion of the Engineer, conditions will permit, and a determination of the density will be made. Density determination will be made based on the water content of the core as taken. WSDOT Test Method 810 shall be used for the determination of core density. Reference cores will be taken at the minimum rate of one for each 2500 square yards of pavement, or fraction thereof. These same cores will be used for thickness measurements as required by Section 5-05.5(1).

The density determined in this manner shall meet the following requirements when compared with the density of plastic concrete as determined by WSDOT Test Method No. 806:

The average density of the cores shall be at least 98 percent of the plastic concrete density with no cores having a density of less than 97.5 percent of the plastic concrete density.

Failure to meet the above requirement will be considered as evidence that the minimum requirements for vibration are inadequate for the job conditions, and additional vibrating units or other means of increasing the effect of vibration shall be employed so that the density of the hardened concrete as indicated by further referee testing shall conform to the above listed requirements. Primary units of pavement, as defined in Section 5-05.5(1), not meeting the prescribed minimum density shall be removed and replaced with satisfactory material. At the option of the Engineer, noncomplying material may be accepted at a reduced price.

The concrete shall be held at a uniform consistency. The slip-form paver shall be operated with as nearly a continuous forward movement as possible and all operations of mixing, delivering, and spreading concrete shall be coordinated to provide uniform progress with stopping and starting of the paver held to a minimum. If, for any reason, it is necessary to stop the forward movement of the paver, the vibratory and tamping elements shall also be stopped immediately. No tractive force shall be applied to the machine, except that which is controlled from the machine.

When concrete is being placed adjacent to an existing pavement, that part of the equipment which is supported on the existing pavement shall be equipped with protective pads on crawler tracks or rubber-tired wheels on which the bearing surface is offset to run a sufficient distance from the edge of the pavement to avoid breaking the pavement edge.

5-05.3(7)B Stationary Side Form Construction

Side form sections shall be straight, free from warps, bends, indentations, or other defects. Defective forms shall be removed from the work. Metal side forms shall be used except at end closures and transverse construction joints where straight forms of other suitable materials may be used.

Side forms may be built up by rigidly attaching a section to either top or bottom of forms. If such build-up is attached to the top of metal forms, the build-up shall be of metal.

Width of the base of all forms shall be equal to at least 80 percent of specified pavement thickness.

Side forms shall be of sufficient rigidity, both in the form and in the interlocking connection with adjoining forms, that springing will not occur under the weight of subgrading and paving equipment or from the pressure of concrete. The Contractor shall provide sufficient forms so that there will be no delay in placing the concrete due to lack of forms.

Before placing side forms, the underlying material shall be at the proper grade. Side forms shall have full bearing upon the foundation throughout their length and width of base and shall be placed to the required grade and alignment of the edge of the finished pavement. They shall be firmly supported during the entire operation of placing, compacting, and finishing the pavement.

Forms shall be drilled in advance of being placed to line and grade to accommodate tie bars where these are specified.

Immediately in advance of placing concrete and after all subgrade operations are completed, side forms shall be trued and maintained to the required line and grade for a distance sufficient to prevent delay in placing concrete.

Side forms shall remain in place at least 12 hours after the concrete has been placed, and in all cases until the edge of the pavement no longer requires the protection of the forms. Curing compound shall be applied to the concrete immediately after the forms are removed.

Side forms shall be thoroughly cleaned and oiled each time they are used and before concrete is placed against them.

Concrete shall be spread, screeded, shaped, and consolidated by one or more self-propelled machines. These machines shall uniformly distribute and consolidate concrete without segregation so that completed pavement will conform to required cross section with a minimum of handwork.

The number and capacity of machines furnished shall be adequate to perform the work required at a rate equal to that of concrete delivery.

Concrete for the full paving width shall be effectively consolidated by means of surface vibrators, in combination with internal vibrators, or by some other method of consolidation that produces equivalent results without segregation.

When vibrators are used to consolidate concrete, the rate of vibration shall be not less than 3,500 cycles per minute for surface vibrators and shall be not less than 7,000 cycles per minute for internal vibrators. Amplitude of vibration shall be sufficient to be perceptible on the surface of the concrete more than 1 foot from the vibrating element. The Contractor shall furnish a tachometer or other suitable device for measuring and indicating frequency of vibration.

Vibrators shall not rest on new pavement or side forms. Power to vibrators shall be connected so that vibration ceases when forward or backward motion of the machine is stopped.

The provisions relating to the frequency and amplitude of internal vibration shall be considered the minimum requirements and are intended to ensure adequate density in the hardened concrete. Referee testing of hardened concrete and all of the requirements of Section 5-05.3(7)A related to density, apply to pavement constructed with stationary side forms.

When concrete is being placed adjacent to an existing pavement, that part of the equipment supported on existing pavement shall be equipped with protective pads on crawler tracks or rubber-tired wheels with the bearing surface offset to run a sufficient distance from the pavement edge to avoid breaking or cracking that edge.

5-05.3(8) Joints

Joints in cement concrete pavement will be designated as longitudinal and transverse contraction joints and longitudinal and transverse construction joints, and shall be constructed as shown in the Plans and in accordance with the following provisions:

All contraction joints shall be constructed at the locations, intervals, and depths shown in the Standard Plan. The faces of all joints shall be constructed perpendicular to the surface of the cement concrete pavement.

5-05.3(8)A Contraction Joints

Transverse contraction joints on cement concrete pavement shall be sawed with suitable power-driven concrete saws. The Contractor shall provide sufficient sawing equipment capable of completing the sawing to the required dimensions and at the required rate to control cracking. The Contractor shall provide adequate artificial lighting facilities for night sawing. Joints shall not vary from the specified or indicated line by more than $\frac{1}{4}$ inch.

Commencement of sawing transverse contraction joints will be dependent upon the setting time of the concrete and shall be done at the earliest possible time following placement of the concrete consistent with being able to saw without tearing or raveling the adjacent concrete excessively. Initial or control transverse contraction joints shall be sawed at every fifth contraction joint at the spacing shown in the Standard Plans but not greater than 64 feet, or at an interval which most effectively minimizes the possibility of uncontrolled cracking. The remaining contraction joints shall be sawed, normally between 24 and 48 hours after the placement of the concrete pavement, as shown in the Standard Plan. When cool weather results in retarded setting of the concrete, the sawing of joints may be deferred only for the time sufficient to preclude excessive tearing of the concrete adjacent to the joint.

The concrete saw shall be powered adequately to perform the required cutting. It shall cut a uniform groove to the required depth and not less than $\frac{3}{16}$ inch nor more than $\frac{5}{16}$ inch in width.

The Contractor will be expected to arrange the scheduling of sawing joints, including initial sawing at the required intervals, so every possible effort is made to control cracking by the use of judiciously spaced and timed sawed joints. In the event random cracks occur, they shall be repaired in accordance with Section 5-05.3(22).

The placement of cork or other types of preformed fillers to form a transverse joint will not be allowed.

Longitudinal contraction joints shall be sawed to the required depth as soon as practical after the initial control transverse contraction joints are completed and not later than 3 days after the concrete pavement has been placed. When sawing is done within 48 hours after the concrete has been placed, water trucks and all equipment other than the saw shall be kept off the pavement.

Any damage to the curing material during the sawing operations shall be repaired immediately after the sawing is completed.

When cement concrete pavement is placed adjacent to existing cement concrete pavement, the vertical face of all existing working joints shall be covered with building paper or other suitable material.

5-05.3(8)B Sealing Sawed Contraction Joints

Sawed contraction joints shall be filled with a joint sealant filler conforming to the requirements of Section 9-04.2. Joints shall be thoroughly clean at the time of sealing and if the hot-poured type is used the joints shall be dry. Care shall be taken to avoid air pockets. The hot-poured compound shall be applied in two or more layers, if necessary. The cold-poured compound shall be applied under sufficient pressure to fill the groove from bottom to top and to a point approximately $\frac{1}{4}$ inch below the surface of the concrete. The joint filled with cold-poured compound shall then be covered with a strip of nonabsorptive paper at least twice as wide as the joint and the paper shall be left in place.

5-05.3(8)C Construction Joints

When placing of concrete is discontinued for more than 45 minutes, a transverse construction joint shall be installed. Construction joints shall be as shown in the Standard Plan.

Transverse construction joints shall be constructed between cement concrete pavement and reinforced concrete bridge approach slabs.

All transverse and longitudinal construction joints, including the joint between new and existing pavement when widened, shall be sawed and sealed with joint filler conforming to the requirements of Sections 5-05.3(8)A and 9-04.2.

5-05.3(9) Reinforcing

Bridge approach slabs shall be reinforced as shown in the Plans, or as designated by the Engineer.

5-05.3(10) Tie Bars and Dowel Bars

Epoxy-coated steel tie bars shall be placed at all longitudinal contraction and construction joints, in accordance with the requirements shown in the Standard Plan. In addition, tie bars shall be installed when concrete shoulders are placed as a separate operation or when widening existing pavement.

Epoxy-coated tie bars shall be placed at longitudinal construction joints between lanes in a manner that the individual bars are located at the required elevation and spaced as shown in the Standard Plan and in a manner that the vertical edge of the concrete is not deformed or otherwise damaged during placement of the bars.

Epoxy-coated dowel bars will be required for the construction joint at the end of paving operations each day and they shall be placed in accordance with the Standard Plan. When required by the contract, epoxy coated dowel bars shall be placed at each transverse contraction joint in accordance with the Standard Plans.

When new concrete pavement is to be placed against existing cement concrete pavement, epoxy-coated tie bars shall be drilled and grouted into the existing pavement with epoxy resin in accordance with the Standard Plan. The Contractor may use any method for drilling the holes, provided the method selected does not damage the existing concrete. Any damage caused by the Contractor's operations shall be repaired by the Contractor at no cost to the Contracting Agency and the repair shall be to the satisfaction of the Engineer.

The tie bar holes shall be blown clean with compressed air before grouting. The bar shall be centered in the hole for the full length of embedment before grouting. The grout shall then be pumped into the hole around the bar in a manner that the back of the hole will be filled first. Blocking or shimming shall not impede the flow of the grout into the hole. Dams, if needed, shall be placed at the front of the holes to confine the grout. The dams shall permit the escape of air without leaking grout and shall not be removed until grout has cured in the hole.

5-05.3(11) Finishing

After the concrete has been given a preliminary finish by means of finishing devices incorporated in the slip-form paving equipment, the surface of the fresh concrete shall be checked by the Contractor with a straightedge device not less than 10 feet in length. High areas indicated by the straightedge device shall be removed by the hand-float method. Each successive check with the straightedge device shall lap the previous check path by at least $\frac{1}{2}$ of the length of the straightedge. The requirements of this paragraph may be waived if it is successfully demonstrated that other means will consistently produce a surface with a satisfactory profile index and meeting the 10-foot straightedge requirement specified in Section 5-05.3(12).

Any edge slump of the pavement, exclusive of specified edging, in excess of $\frac{1}{4}$ inch shall be corrected before the concrete has hardened. If edge slump on any 1 foot or greater length of hardened concrete exceeds 1 inch, the entire panel between the transverse and longitudinal joints shall be removed and replaced with concrete true to the specified line, grade, and cross-section.

The pavement shall be given a final finish surface by texturing with a comb perpendicular to the center line of the pavement. The comb shall produce striations approximately 0.015 foot in depth at approximately $\frac{1}{2}$ -inch spacings in the fresh concrete. The actual nominal depths of the striations shall be determined in the field by the Engineer. The comb shall be operated mechanically either singly or in gangs with several placed end to end. Finishing shall take place with the elements of the comb as nearly perpendicular to the concrete surface as is practical, to eliminate dragging the mortar. If the striation equipment has not been previously approved, a test section shall be constructed prior to approval of the equipment. If the pavement has a raised curb without a formed concrete gutter, the texturing shall end 2 feet from the curb line.

At the beginning and end of paving each day, the Contractor shall, with an approved stamp, indent the concrete surface near the right hand edge of the panel to indicate the date, month, and year of placement.

At approximate 500-foot intervals where designated by the Engineer the Contractor shall, with an approved stamp, indent the concrete surface near the right hand edge of the pavement with the stationing of the roadway.

5-05.3(12) Surface Smoothness

The pavement smoothness will be checked under supervision of the Engineer no later than 5:00 p.m. of the day following placement of concrete, with equipment furnished and operated by the Contractor. Smoothness of all pavement placed except shoulders, ramp tapers, and small or irregular areas as defined by Section 5-05.3(3) unless specified otherwise, will be measured with a recording profilograph, as specified in Section 5-05.3(3), parallel to centerline, from which the profile index will be determined in accordance with WSDOT Test Method 807.

For the purpose of qualifying the equipment and methods used by the Contractor, a daily profile index will be computed. For pavement placed in a 12-foot width or less, the daily profile index will be the average of two profiles made approximately 3 feet from and parallel to each edge of the pavement. If the pavement is placed in a width greater than 12 feet, the daily profile index will be computed as the average of profiles made approximately 3 feet from and parallel to each edge and at the approximate location of each planned longitudinal joint.

The daily profile index of the finished pavement thus determined will be 7 inches per mile, or less. Only equipment and methods that consistently produce a finished surface meeting this requirement shall be used. Should the daily profile index exceed the rate of 7 inches per mile, the paving operations shall be discontinued until other methods or equipment are provided by the Contractor. Such revised methods and equipment shall again be discontinued if they do not produce a finished surface having a daily profile index of 7 inches per mile, or less. Operations shall not be resumed until the Engineer approves further changes in methods and equipment as proposed by the Contractor.

All areas representing high points having deviations in excess of 0.3 inch as determined by procedures described in WSDOT Test Method 807, shall be reduced by abrasive methods until such deviations do not exceed 0.1 inch as determined by reruns of the profilograph. High areas of individual profiles shall be reduced by abrasive means so that the profile index will not exceed 0.7 inch in any 0.1-mile section. All high areas in excess of 0.1 inch shall be reduced to 0.0 inch prior to reducing any high points of 0.1 inch or less. Low spots exceeding $\frac{1}{4}$ inch shall be filled with an approved epoxy-bonded grout in a manner approved by the Engineer.

When any of the daily profile indexes exceed 7 inches per mile, final acceptance of the pavement for smoothness parallel to the centerline will be based on profile indexes as measured with the profilograph, operating by the Contractor under the supervision of the Engineer, along a line parallel to the edge of pavement and each longitudinal joint and will not be averaged for acceptance purposes. The final acceptance profile indexes will be measured after all corrective work is complete and will demonstrate that all 0.1-mile sections on the project are within the 0.7-inch specification.

When cement concrete pavement abuts bridges, the finished pavement parallel to centerline within 15 feet of the abutting joint shall be uniform to a degree that no variations greater than $\frac{1}{8}$ inch are present when tested with a 10-foot straightedge.

When paving small or irregular areas, as defined in Section 5-05.3(7), surface smoothness will be measured with a 10-foot straightedge no later than 5:00 p.m. of the day following the placing of the concrete. A 10-foot straightedge will be placed parallel to the centerline so as to bridge any depressions and touch all high spots. Should the surface vary more than $\frac{1}{8}$ inch from the lower edge of the straightedge, the high portion shall be reduced by the Contractor to the $\frac{1}{8}$ -inch tolerance by abrasive means at no expense to the Contracting Agency. It is further provided that if reduction of high portions of the surface

involves breaking, dislodging, or other disturbance of the aggregates, such cutting will not be permitted until the pavement has achieved its design age. If in the opinion of the Engineer irregularities cannot be satisfactorily removed by such methods, the Contractor shall remove and replace the pavement at no expense to the Contracting Agency.

Smoothness perpendicular to the centerline will be measured with a 10-foot straight edge. The transverse slope of the finished pavement shall be uniform to a degree such that no variations greater than $\frac{1}{4}$ inch are present when tested with a 10-foot long straightedge laid in a direction perpendicular to the centerline. Any areas that are in excess of this specified tolerance shall be corrected by abrasive means.

5-05.3(13) Curing

Immediately after the finishing operations have been completed and as soon as marring of the concrete will not occur, the entire surface of the newly placed concrete shall be covered and cured in accordance with one of the following methods the Contractor may elect.

5-05.3(13)A Curing Period

Regardless of the curing method used, the Contractor shall maintain curing protection and shall protect the pavement from damage from any cause for at least the length of time shown in the following table for the various mixes, or for a greater length of time, as determined by the Engineer.

Mix	Min. Period for Maintaining Curing Protection	Min. Period Before Opening to Traffic
14 day (Std.)	10 days	14 days
10 day	9 days	10 days
7 day	7 days	7 days
5 day	5 days	5 days
4 day	4 days	4 days
3 day	3 days	3 days

5-05.3(13)B Curing Compound

Liquid membrane-forming concrete curing compound Type 2 meeting the requirements of Section 9-23.2 shall be applied to the entire area of the exposed surface of the concrete with an approved mechanical spray machine. The spray fog shall be protected from the wind with an adequate shield. It shall be applied uniformly at the rate of one gallon to not more than 150 square feet.

The compound shall be applied with equipment of the pressure tank or pump type equipped with a feed tank agitator which ensures continuous agitation of the compound during spraying operations. The nozzle shall be of the two line type with sufficient air to properly atomize the compound.

The curing compound shall not be applied during or immediately after rainfall. If it becomes necessary to leave the pavement uncoated overnight, it shall be covered with polyethylene sheeting which shall remain in place until weather conditions are favorable for the application of the curing compound.

In the event that rain falls on the newly coated pavement before the film has dried sufficiently to resist damage, or in the event of damage to the film from any cause, the Contractor shall apply a new coat of curing compound in one or two applications to the affected area at the rate which, in the opinion of the Engineer, will result in a film of curing value equal to that specified in the original coat.

Containers of curing compound shall be distributed on the work in a manner to enable the Engineer to determine the rate of application being used at any time. All curing compound placed in the spray tanks shall be withdrawn directly from manufacturer's original containers bearing the manufacturer's name, brand, and lot number.

Before placing the curing compound in the spray tank, it shall be thoroughly agitated as recommended by the Manufacturer. The compound shall not be diluted by the addition of solvents nor be altered in any manner. If the compound has become chilled to the extent that it is too viscous for proper stirring or application or if portions of the vehicle have been precipitated from solution, it shall be heated to restore proper fluidity but it shall not be heated above 100 F.

The curing compound shall be applied immediately after the concrete has been finished and after any bleed water that has collected on the surface has disappeared, or at a time designated by the Engineer. If hair checking develops in the pavement before finishing is completed, the Engineer may order the application of the curing compound at an earlier stage, in which event any concrete cut from the surface in finishing operations shall be removed entirely from the pavement. If additional mortar is then needed to fill torn areas, it shall be obtained ahead of the spraying operations. All areas cut by finishing tools subsequent to the application of the curing compound shall immediately be given new applications at the rate specified above.

The compound, after application, shall be protected by the Contractor from injury for the period of time specified above. All traffic, either by foot or otherwise, shall be considered as injurious to the film of the applied compound.

The Contractor shall provide on the job a sufficient quantity of white polyethylene sheeting to cover all the pavement laid in three hours of maximum operation. This sheeting shall be reserved exclusively for the protection of the pavement in case of rain or breakdown of the spray equipment used for applying the curing compound. The protective sheeting shall be placed over the pavement when ordered, and in the manner specified by the Engineer.

Areas from which it is impossible to exclude traffic shall be protected by a covering of sand or earth not less than 1 foot in thickness or by other suitable and effective means. The protective covering shall be placed no earlier than 24 hours after application of the compound.

All liquid membrane-forming curing compounds shall be removed from the Portland cement concrete pavement to which traffic delineators are to be bonded. Curing compound removal shall not be started until the pavement has attained sufficient flexural strength for traffic to be allowed on it. The Contractor shall submit a proposed removal method to the Engineer and shall not begin the removal process until the Engineer has approved the removal method.

The Contractor shall assume all liabilities for and protect the Contracting Agency from any damages or claims arising from the use of materials or processes described herein.

5-05.3(13)C White Polyethylene Sheeting

The sheeting shall be placed over the pavement immediately after finishing operations are completed, or at a time designated by the Engineer.

The sheeting shall be laid so that individual sheets overlap at least 2 feet, and the lapped areas shall be held in close contact with the pavement by weighting with earth or boards to prevent movement by the wind. The sheeting shall extend downward to cover the edges of the pavement and shall be secured to the subgrade with a continuous bank of earth or surfacing material. Any holes occurring in the sheeting shall be patched immediately to the satisfaction of the Engineer. The sheeting shall be maintained against injury and remain in place the minimum period of time as specified above.

5-05.3(13)D Wet Curing

As an alternative to the above curing methods or as directed by the Engineer, the Contractor may wet cure the concrete pavement. Wet curing shall be accomplished by applying a continuous fog or mist spray to the entire pavement surface for a minimum of seven days. If water runoff is not a concern, continuous sprinkling is acceptable. Sprinkling shall not begin until the concrete has achieved initial set as determined by AASHTO T 197 or other approved method.

5-05.3(14) Cold Weather Work

When the air temperature is expected to reach the freezing point during the day or night and the pavement has not cured for 50 percent of the time specified in Section 5-05.3(13)A, the concrete shall be protected from freezing. The Contractor shall, at no expense to the Contracting Agency, provide a sufficient supply of straw, hay, grass, earth, blankets, or other suitable blanketing material and spread it over the pavement to a sufficient depth to prevent freezing of the concrete. The Contractor shall be responsible for the quality and strength of the concrete thus cured. Any concrete injured by frost action or freezing shall be removed and replaced at the Contractor's expense in accordance with these Specifications.

5-05.3(15) Concrete Pavement Construction in Adjacent Lanes

Unless otherwise shown in the Plans or in the Special Provisions, the pavement shall be constructed in multiple lanes; that is, two or more adjacent lanes paved in a single operation. Longitudinal contraction joints shall be used between adjacent lanes that are paved concurrently, and construction joints shall be used when lanes are paved separately. Tie bars shall be installed during initial lane construction. Concrete shall not be placed in succeeding lanes until that in adjacent lanes has acquired a modulus of rupture of not less than 500 psi as measured by test beams cast at the time the concrete is placed.

The Contractor shall replace, at no expense to the Contracting Agency any panels on the new pavement that are cracked or broken as a result of the Contractor's operations.

5-05.3(16) Protection of Pavement

The Contractor shall protect the pavement and its appurtenances from any damage. Protection shall include personnel to direct traffic and the erection and maintenance of warning signs, lights, barricades, temporary take-down bridges across the pavement with adequate approaches, and whatever other means may be necessary to accommodate local traffic and to protect the pavement during the curing period or until opened to traffic as determined by the Engineer.

The operation of construction equipment on the new pavement will not be allowed prior to three days minimum cure and 90 percent of design strength. Exceptions would be light vehicles required for sawing operations of taking cores of the finished pavement.

Placement of shoulder material may commence no sooner than seven days after concrete is placed unless approved by the Engineer.

A continuous barrier of the design shown in the Plans shall be constructed and maintained along the edge of the pavement being constructed and adjacent to the portion of the roadway used for traffic. The barriers shall be left in place until the new pavement is ready to be opened to traffic and shall then be removed by the Contractor.

Any damage to the pavement occurring prior to final acceptance shall be replaced or repaired in accordance with Section 5-05.3(22).

5-05.3(17) Opening to Traffic

As directed by the Engineer, the pavement may be opened to traffic when the pavement has reached its design age or has developed 90 percent of the flexural design strength as determined from beams, made at the time of placement, cured under comparable conditions, and tested in accordance with WSDOT Test Method No. 802. Prior to opening to traffic, the pavement shall be cleaned.

5-05.3(18) Cement Concrete Approach

Concrete approaches shall be constructed at the locations shown in the Plans or as staked by the Engineer and in accordance with the Standard Plan.

The provisions of Section 5-05 shall pertain in the construction of concrete approaches, and, in addition, the following shall apply:

Placing, Compacting, and Finishing: Concrete may be placed, compacted, and finished using hand methods. The tools required for these operations shall be approved by the Engineer.

5-05.3(19) Reinforced Concrete Bridge Approach Slabs

Approach slab concrete shall be Class 4000 conforming to the requirements of Section 6-02.

Reinforced concrete bridge approach slabs shall be constructed at the locations shown in the Plans or as staked by the Engineer and in accordance with the contract documents.

The approach slabs shall be constructed full bridge deck width from outside usable shoulder to outside usable shoulder at an elevation to match the structure. Pavement ends and the bridge ends of the approach slabs shall be constructed as shown in the Plans. The approach slabs shall be modified as shown in the Plans to accommodate the grate inlets at the bridge ends if the grate inlets are required.

Screed rail support, installation, and finish machine requirements shall be as specified for bridge deck slabs.

Reinforced concrete bridge approach slab anchors shall be installed as detailed in the Plans. The anchor rods shall conform to ASTM A 307. The steel plates shall conform to AASHTO M 183M. The anchors shall be installed parallel both to profile grade and center line of roadway. The Contractor shall secure the anchors to ensure that they will not be misaligned during concrete placement. For Method A anchor installations, the grout or adhesive used to install the anchors shall have a minimum compressive strength of 4,000 psi at three days and be capable of developing the ultimate strength of the anchor rod. Compressive strength shall be determined in accordance with AASHTO T 106.

The compression seal shall be as noted in the contract documents.

Finishing of the reinforced concrete bridge approach slabs shall be accomplished by either a combination of finishing machine and hand finishing or by hand finishing methods only. The finished and cured approach slabs shall be free from any deviation exceeding $\frac{1}{8}$ inch under a 10-foot straightedge placed parallel and perpendicular to the center line of the roadway.

5-05.3(20) Vacant

5-05.3(21) Vacant

5-05.3(22) Repair of Defective Pavement Slabs

Broken slabs, random cracks, nonworking contraction joints near cracks, and spalls along joints and cracks shall be replaced or repaired as specified at no expense to the Contracting Agency, and shall be accomplished prior to completion of joint sealing.

Pavement slabs containing multiple cracks through the full depth of the slab, separating the slab into three or more parts, shall be entirely removed and replaced. Pavement slabs containing a single diagonal crack intersecting the transverse and longitudinal joints within $\frac{1}{2}$ of the width and length of the slab from the corner shall be repaired by removing and replacing the smaller portion of the slab.

Random cracks penetrating the full depth of the pavement shall be grooved and sealed. The top of the crack shall be grooved to a minimum depth of $\frac{3}{4}$ inch and to a width not less than $\frac{3}{8}$ inch nor more than $\frac{5}{8}$ inch by means of an approved grooving machine. The grooving machine shall be capable of following closely the path of the crack and of widening the top of the crack to the required section without spalling or otherwise damaging the concrete. Loose and fractured concrete shall be removed, and the groove shall be thoroughly cleaned and sealed. Random cracks that are tight and that do not penetrate the full depth of the pavement shall be left undisturbed. When necessary, the depth of crack penetration shall be determined by inspection of cores drilled at the Contractor's expense.

When a transverse random crack terminates in or crosses a transverse contraction joint, the uncracked portion of the joint shall be filled with epoxy-resin mortar or grout and the crack shall be routed and sealed. When a transverse random crack approximately parallels the planned contraction joint and is within a distance of 5 feet from a contraction joint in the pavement, the crack shall be routed and sealed, and the joint shall be filled with epoxy-resin mortar or grout. When a transverse random crack is more than 5 feet from the nearest contraction joint in the pavement, both the joint and the crack shall be sealed. Joints to be filled with epoxy-resin mortar or grout shall be thoroughly cleaned.

Spalls shall be repaired by making a saw cut at least 1 inch outside the spalled area and to a minimum depth of 2 inches. When the spalled area abuts a joint, the saw cut shall be made to a depth of 2 inches or $\frac{1}{6}$ the slab thickness, whichever is greater. The concrete between the saw cut and the joint or primary crack shall be chipped out to solid concrete. The cavity thus formed shall be thoroughly cleaned of all loose material. A prime coat of epoxy-resin binder shall be applied to the dry, cleaned surface of all sides of the cavity, except the joint or primary crack face. The prime coat shall be applied by scrubbing prime coat material into the surface with a stiff-bristle brush. Placement of Portland cement concrete or epoxy-resin concrete or mortar shall immediately follow the application of the prime coat. If the spalled area to be patched abuts a working joint or a working crack which penetrates the full depth of a slab, an insert or other bond-breaking medium shall be used to maintain working joints or cracks during the repair work.

5-05.4 Measurement

Cement concrete pavement will be measured by the square yard for the completed pavement. Furnishing and delivering concrete for cement concrete pavement will be measured by the cubic yard based on batch plant weights. The batch plants shall be equipped with an acceptable recording device capable of producing an accurate record of the quantity of individual materials incorporated into each batch of concrete. A copy of this record shall be furnished the Engineer daily. Measurement of concrete quantities will be based on this record, corrected daily for yield and waste. The width for square yard measurement will be the width of the pavement shown on the typical cross-section on the Plans, additional widening where called for, or as otherwise specified in writing by the Engineer. The length will be measured horizontally along the center line of each roadway or ramp.

Epoxy-coated steel reinforcing bar for bridge approach slab and steel reinforcing bar for bridge approach slab will be measured by the pound as specified in Section 6-02.4.

Epoxy-coated tie bar with drill hole and epoxy-coated dowel bars will be measured by the unit for the actual number of bars used in the completed work.

Bridge approach slab anchors will be measured by the unit for the actual number of anchors used in the completed work.

Concrete Class 4000 for bridge approach slabs will be measured by the cubic yard as specified in Section 6-02.4.

Cement concrete approach will be measured by the square yard.

The area for calculation of ride smoothness compliance adjustment is the area of pavement, in square yards, represented by profilogram.

5-05.5 Payment

Payment will be made in accordance with Section 1-04.1, for each of the following bid items that are included in the proposal:

"Cement Conc. Pavement", per square yard.

"Furnishing — Day Conc. for Cement Conc. Pavement", per cubic yard.

"Cement Conc. Approach ____ Day", per square yard.

"Epoxy-Coated Tie Bar with Drill Hole", per each.

"Epoxy-Coated Dowel bar", per each.

"Conc. Class 4000 For Bridge Approach Slab", per cubic yard.

All costs for providing, placing, and compacting the crushed surfacing top course and furnishing and installing the compression seal shall be included in the unit contract price per cubic yard for "Conc. Class 4000 for Bridge Approach Slab".

"Bridge Approach Slab Anchor", per each.

"St. Reinf. Bar for Bridge Approach Slab", per pound.

"Epoxy-Coated St. Reinf. Bar for Bridge Approach Slab", per pound.

"Ride Smoothness Compliance Adjustment", by calculation.

Payment for "Ride Smoothness Compliance Adjustment" will be calculated by multiplying the unit contract price for cement concrete pavement, times the area for adjustment, times the percent of adjustment determined from the schedule below.

1. Adjustment will be based on the initial profile index before corrective work.

2. "Ride Smoothness Compliance Adjustment" will be calculated for each 0.1-mile section represented by profilogram using the following schedule:

Profile Index (inches per mile)	Ride Smoothness Compliance Adjustment (percent adjustment)
1.0 or less	+4
over 1.0 to 2.0	+3
over 2.0 to 3.0	+2
over 3.0 to 4.0	+1
over 4.0 to 7.0	0
over 7.0	-2*

*Also requires correction to 7.0 inches per mile.

5-05.5(1) Pavement Thickness

It is the intent of the specifications that cement concrete pavement shall be constructed in accordance with the thickness requirements in the Plans and specifications. Tolerances allowed for subgrade construction and other provisions which may affect thickness shall not be construed to modify such thickness requirements.

For the purposes of these Specifications, a primary unit of pavement is defined as the area of pavement placed in each day's paving operations. Within such primary unit of pavement, there may be an area or areas which are deficient in thickness by more than 0.05 feet. This deficient area or areas will be defined as a secondary unit or units. If secondary units are found to exist, the primary unit area will be reduced by the secondary unit area included therein. At a time determined by the Engineer, thickness measurements will be made in each primary unit of pavement at the minimum rate of one measurement for each 2500 square yards of pavement, or fraction thereof. The exact location and number of thickness measurements within each primary unit, both longitudinally and transversely, will be determined by the Engineer. In general, thickness measurements will be made at uniform intervals throughout each primary unit of pavement.

If thickness deficiencies greater than 0.05 foot are found to exist, supplemental thickness measurements will be made in accordance with Section 5-05.5(1)B. Pavement thickness variations, if any, from the thickness requirements in the Plans and specifications will be determined by comparing the actual thickness measurement with the thickness specified at the location where the measurement was made. Such variation will be determined to the nearest 0.01 foot as either excess or deficient thickness.

No additional pay will be allowed the Contractor for any pavement constructed in excess of the thickness requirements of the Plans and specifications.

If the Contractor believes that the number of thickness measurements made in primary unit areas are insufficient to fairly indicate the actual thickness of pavement placed, the Contractor may request that additional thickness measurements be made by the Engineer. Such additional measurements will be used in determining the average thickness variation. The location of all additional thickness measurements will be determined by the Engineer except that they will be spaced not closer than 200 feet. The cost of all such additional measurements made, including filling of the core holes with concrete, will be deducted from any monies due or that may become due the Contractor under the contract at the rate of \$150.00 per core.

9-01 PORTLAND CEMENT**9-01.1 Types of Cement**

Cement shall be classified as Portland cement or blended hydraulic cement.

9-01.2 Specifications**9-01.2(1) Portland Cement**

Portland cement shall conform to the requirements for Types I, II, or III cement of the Standard Specifications for Portland Cement, AASHTO M 85, except that the content of alkalis shall not exceed 0.75 percent by weight calculated as Na₂O plus 0.658 K₂O.

Type II cement shall meet the requirements of the above specifications for compressive strength and for time of setting by the Vicat method, AASHTO T 131.

9-01.2(2) Vacant**9-01.2(3) Low Alkali Cement**

When the Special Provisions state that low alkali cement shall be used, the percentage of alkalis in the cement shall not exceed 0.60 percent by weight calculated as Na₂O plus 0.658 K₂O. This limitation shall apply to all types of Portland cement.

9-01.2(4) Blended Hydraulic Cement

Blended hydraulic cement shall conform to the requirements for Type IP (MS) or Type I (PM)(MS) cement of the Standard Specification for Blended Hydraulic Cements, AASHTO M 240 with the additional requirement that the maximum fly ash content shall be 25 percent of the cementitious material. The source of the fly ash, as well as the weight of fly ash as a percent by weight of total cement plus fly ash, shall be certified on the cement mill test certificate.

9-01.3 Tests and Acceptance

Cement may be accepted by the Engineer based on the Manufacturer's Mill Test Report indicating full conformance to the Specifications. All shipments of the cement to the Contractor or concrete supplier shall identify the applicable Mill Test Report. The concrete supplier or Contractor shall provide mill test identification on all concrete deliveries.

Each mixing facility or plant utilizing Portland cement shall be equipped with a suitable means or device for obtaining a representative sample of the cement. The device shall enable the sample to be readily taken in proximity to the cement weigh hopper and from a container or conveyor holding only cement.

Cement may be tested using samples taken at the job site by the Engineer for submission to the Olympia Service Center Materials Laboratory for testing.

9-01.4 Storage on the Work Site

The cement shall be stored on the site in a manner as to permit easy access for inspection and identification.

Cement shall be adequately protected at all times from rain and dampness. Cement which, in the opinion of the Engineer, contains lumps that will not be pulverized in the mixer shall be rejected.

Type III Portland cement stored by the Contractor for a period longer than 30 days, or Types I or II Portland cement stored by the Contractor for a period longer than 60 days, shall be held for retest. If the cement has lost strength during the period of storage, as shown by tests of the Contracting Agency, sufficient additional cement shall be added to the mix at the Contractor's expense to overcome such loss, or the cement may be rejected. The amount of cement to be added to the mix shall be determined by the Engineer.

9-02 BITUMINOUS MATERIALS**9-02.1 Asphalt Material, General**

Asphalt furnished under these Specifications shall not have been distilled at a temperature high enough to injure by burning or to produce flecks of carbonaceous matter, and upon arrival at the work, shall show no signs of separation into lighter and heavier components.

9-02.1(1) Vacant**9-02.1(2) Medium-Curing (MC) Liquid Asphalt**

		WSDOT				
		Test				
Characteristics		Method	MC-70	MC-250	MC-800	MC-3000
Kinematic Viscosity at 140 F cSt		202	70-140	250-500	800-1600	3000-6000
Flash Point (Tag Open Cup)	Min. F	207	100	150	150	150
Water Content	Max. %	217	0.2	0.2	0.2	0.2
Distillation: volume % of total distillate to 680 F		211				
			0-20	0-10	---	---
			20-60	15-55	0-35	0-15
			65-90	60-87	45-80	15-75
Residue of 680 F distillation % volume by difference	Min.		55	67	75	80
Properties of residue from distillation to 680 F						
Absolute viscosity at 140 F, poise		203	300-1200	300-1200	300-1200	300-1200
¹ Ductility, 5 cm/min. at 77 F, cm	Min.	213	100	100	100	100
Solubility in trichloroethylene	Min. %	214	99.0	99.0	99.0	99.0

¹If the ductility at 77 F is less than 100, the material will be acceptable if its ductility at 60 F is more than 100.

The material shall not foam when heated to the application temperature recommended in Section 5-02.3(3).

9-02.1(3) Rapid-Curing (RC) Liquid Asphalt

Characteristics	WSDOT Test				
	Method	RC-70	RC-250	RC-800	RC-3000
Kinematic Viscosity at 140 F cSt	202	70-140	250-500	800-1600	3000-6000
Flash Point (Tag Open Cup)	Min. F 207	---	80	80	80
Water Content	Max. % 217	0.2	0.2	0.2	0.2
Distillation: volume % of total distillate to 680 F	211				
to 374 F	Min.	10	---	---	---
to 437 F	Min.	50	35	15	---
to 500 F	Min.	70	60	45	25
to 600 F	Min.	85	80	75	70
Residue of 680 F distillation % volume by difference	Min.	55	65	75	80
Properties of residue from distillation to 680 F					
Absolute viscosity at 140 F, poise	203	600-2400	600-2400	600-2400	600-2400
Ductility, 5 cm/min. at 77 F	Min. 213	100	100	100	100
Solubility in trichloroethylene	Min. % 214	99.0	99.0	99.0	99.0

The material shall not foam when heated to application temperature recommended in Section 5-02.3(3).

9-02.1(4) Asphalt Cements**9-02.1(4)A Paving Asphalt**

Characteristics	WSDOT Test Method	Viscosity Grade	
		AR-4000W	AR-2000W
Tests on Residue from RTFC			
Procedure ^{note 1}	208		
Absolute Viscosity at 140 F, poise	203	2500-5000	2500-5000
Kinematic Viscosity at 275 F cSt, min.	202	275	200
Penetration at 77 F 100g/5 sec, min.	201	40	50
Percent of original penetration at 77 F min.	note 2	45	40
Ductility at 45 F (1 cm/min.) cm. min.	213	10	20

Characteristics	WSDOT	Viscosity Grade	
	Test Method	AR-4000W	AR-2000W
Test on Original Asphalt			
Flashpoint (Cleveland Open Cup)			
F min.	206	440	425
Solubility in Trichloroethylene, % min.	214	99.0	99.0

note 1 TFO may be used but RTFC shall be the referee method.

note 2 Original penetration as well as penetration after RTFC loss will be determined by WSDOT Test Method 201.

9-02.1(4)B Modified Paving Asphalt

	AASHTO Test Method	Specification	Requirements
		PBA-6	PBA-6GR
Penetration (39.2 F, 200g, 60s), dmm			
RTFO Aged Residue ^{note 2}	T-49	30+	30+
Absolute Viscosity 140 F, p ^{note 5}			
Original Binder	T-202	2000+	2000+
RTFO Aged Residue	T-202	5000+	5000+
Kinematic Viscosity 275 F, cSt			
Original Binder	T-201	2000-	2000-
RTFO Aged Residue	T-201	275+	275+
Absolute Viscosity Ratio 140 F			
RTFO Viscosity/Original Viscosity		4.0-	4.0-
Flash Point, Cleveland Open Cup, F			
Original Binder	T-48	450+	450+
Ductility (77 F, 5cm/min), cm			
RTFO Aged Residue	T-51	60+	—

PBA-6GR shall contain not less than 10 percent by weight of total material of powdered rubber meeting the requirements described below for sieve analysis and chemical properties.

Sieve Analysis

Sieve Size	Percent Passing
No. 60	99-100
No. 80	89-100
No. 100	74-90
No. 200	24-90

Chemical Properties

Acetone Extract (ASTM D 297) % max.	23
Ash (ASTM D 297B) % max.	7
Carbon Black (ASTM D 297B) % max.	34
Rubber Hydrocarbon (by difference) % max.	42
Specific Gravity (ASTM D 297)	1.15±0.02
Moisture Content % max.	1.0

note 2 "RTFO Aged Residue" means the asphaltic residue obtained using the Rolling Thin-Film Oven Test (RTFO Test), AASHTO T 240 or ASTM D 2872.

note 5 The Absolute Viscosity (140 F) of PBA-6 and PBA-6GR will be determined at 1 sec⁻¹ using ASTM P 159 (Vol. 4.03, 1985) with Asphalt Institute Vacuum Capillary Viscometers.

9-02.1(5) Recycling Agent

Recycling agents shall conform to the following requirements:

HOT Mix Recycling Agents ^{note 1}					
Test	Test Method	RA 5		RA 25	
		Min.	Max.	Min.	Max.
Original Test					
Viscosity at 140 F cs	D2170 or D2171	200	800	1,000	4,000
Flashpoint COC, F	D92	400	---	425	---
Saturates, Wt. %	D2007	---	30	---	30
Specific Gravity	D70 or D1298	Report		Report	
Residue Test from RTFC	D2872 ^{note 2}				
Viscosity Ratio ^{note 3}	---	---	3	---	3
Mass Change ± %	---	---	4	---	3

note 1 The final acceptance of recycling agents meeting this specification is subject to the compliance of the reconstituted asphalt blends with current asphalt specifications.

note 2 The use of ASTM D 1754 has not been studied in the context of this specification; however, it may be applicable. In cases of dispute, the reference method shall be ASTM D 2872.

$$\text{note 3 Viscosity Ratio} = \frac{\text{RTFC Viscosity at 140 F, cs}}{\text{Original Viscosity at 140 F, cs}}$$

HOT Mix Recycling Agents ^{note 1}							
Test	ASTM	RA 75		RA 250		RA 500	
	Test Method	Min.	Max.	Min.	Max.	Min.	Max.
Original Test Viscosity at 140 F, cs	D2170 or D2171	5,000	10,000	15,000	35,000	40,000	60,000
Flashpoint COC, F	D92	450	---	450	---	450	---
Saturates, Wt. %	D2007	---	30	---	30	---	30
Specific Gravity	D70 or D1298	Report		Report		Report	
Residue Test from RTFC	D2872 ^{note 2}						
Viscosity Ratio ^{note 3}		---	3	---	3	---	3
Weight Change \pm %		---	2	---	2	---	2

^{note 1} The final acceptance of recycling agents meeting this specification is subject to the compliance of the reconstituted asphalt blends with current asphalt specifications.

^{note 2} The use of ASTM D 1754 has not been studied in the context of this specification; however, it may be applicable. In cases of dispute, the reference method shall be ASTM D 2872.

$$\text{note 3 Viscosity Ratio} = \frac{\text{RTFC Viscosity at 140 F, cs}}{\text{Original Viscosity at 140 F, cs}}$$

9-02.1(6) Cationic Emulsified Asphalt

See table on page 9-11.

9-02.1(7) Asphalt for Sub-Sealing

Asphalt for sub-sealing shall conform to the requirements of AASHTO M 238 except that the minimum softening point shall be 170 F.

9-02.1(8) Hot Melt Traffic Button Adhesive

The bitumen adhesive material shall conform to the following requirements:

Specification	ASTM Test Method	Requirement
Flash Point, COC F	D 92	550 Min.
Softening Point, F	D 36	200 Min.
Brookfield Viscosity, 400 F	D 2196	7,500 cP, Max.
Penetration, 100g, 5 sec, 77 F	D 5	10-20 dmm
Filler Content, % by weight (Insoluble in 1,1,1 Trichloroethane)	D 2371	50-75

Filler material shall be calcium carbonate and shall conform to the following fineness:

Sieve Size	Percent Passing
No. 100	100
No. 200	95
No. 325	75

Hot melt bitumen adhesive shall develop bond pull-off strength greater than 100 psi between 0 F and 120 F.

9-02.1(9) Coal Tar Pitch Emulsion

Coal tar pitch emulsion shall conform to all requirements of Federal Specification R-P-355. The emulsion shall be prepared from straight run, high temperature, coke oven tar meeting the requirements of Federal Specification RC 1424. The emulsion shall be homogeneous and shall show no separation or coagulation of components that cannot be overcome by moderate stirring. It shall be capable of being applied completely by squeegee, brush, or other approved mechanical methods to the surface of bituminous pavements when spread at the specified rates.

9-02.2 Sampling and Acceptance

9-02.2(1) Certification of Shipment

Bituminous materials may be accepted by the Engineer based on the asphalt supplier's Certification of Compliance incorporated in their Bill of Lading. The Certification will include a statement certifying specification compliance for the product shipped. Failure to provide this Certification with the shipment shall be cause for rejection of the material. The following information is required on the Bill of Lading:

1. Date
2. Contract No. and/or Project Name
3. Grade of Commodity and Certification of Compliance
4. Anti-strip Type
5. Percent Anti-strip
6. Mass (Net Tons)
7. Volume (Gross Gallons)
8. Temperature of Load (F)
9. Bill of Lading Number
10. Consignee and Delivery Point
11. Signature of Supplier's Representative
12. Supplier (Bill of Lading Generator)
13. Supplier's Address
14. Refiner
15. Refiner's Location

The Bill of Lading shall be supplied at the time of shipment of each truck load, truck and trailer, or other lot of asphalt. In addition to the copies the Contractor requires, one copy of the Bill of Lading including the Certification Statement shall be sent with the shipment for agency use and one copy sent on a weekly basis to the Olympia Service Center Materials Laboratory, P.O. Box 167, Olympia, WA 98507-0167.

Cationic Emulsified Asphalt																	
Grade	Type	Rapid Setting				Medium Setting						Slow Setting				Special Tack	
	WSDOT Test Method	CRS-1		CRS-2		CMS-2S		CMS-2		CMS-2h		CSS-1		CSS-1h		STE-1	
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Tests on Emulsions:																	
Viscosity Saybolt Furol S @ 77 F (25 °C)	212	—	—	—	—	—	—	—	—	—	—	20	100	20	100	—	30
Viscosity Saybolt Furol S @ 122 F (50 °C)	212	20	100	150	400	50	450	50	450	50	450	—	—	—	—	—	—
Storage stability test 1 day %	212	—	1	—	1	—	1	—	1	—	1	—	1	—	1	—	1
Demulsibility 35 ml 0.8% sodium dioctyl sulfosuccinate, % ^a	212	40	—	40	—	—	—	—	—	—	—	—	—	—	—	25	—
Coating ability & water resistance:																	
Coating, dry aggregate	212	—	—	—	—	Good	—	Good	—	Good	—	—	—	—	—	—	—
Coating, after spraying	212	—	—	—	—	Fair	—	Fair	—	Fair	—	—	—	—	—	—	—
Coating, wet aggregate	212	—	—	—	—	Fair	—	Fair	—	Fair	—	—	—	—	—	—	—
Coating, after spraying	212	—	—	—	—	Fair	—	Fair	—	Fair	—	—	—	—	—	—	—
Particle charge test	212	Pos	—	Pos	—	Pos	—	Pos	—	Pos	—	Pos ^b	—	Pos ^b	—	Pos	—
Sieve Test, %	212	—	0.10	—	0.10	—	0.10	—	0.10	—	0.10	—	0.10	—	0.10	—	0.10
Cement mixing test, %	212	—	—	—	—	—	—	—	—	—	—	—	2.0	—	2.0	—	—

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Grade Max.	Type	Rapid Setting				Medium Setting						Slow Setting				Special Tack
	WSDOT Test Method	CRS-1		CRS-2		CMS-2S		CMS-2		CMS-2h		CSS-1		CSS-1h		STE-1
		Min.	Max	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
Distillation:																
Oil distillate by vol. of emulsions %	212	—	3	1.5	3	—	20	—	12	—	12	—	—	—	—	5
Residue, %	212	60	—	65	—	60	—	65	—	65	—	57	—	57	—	45
Tests on residue from distillation tests:																
Penetration, 77 F (25° C)	201	100	250	100	250	100	250	100	250	40	90	100	250	40	90	100
Ductility, 77 F (25° C)																
5 cm/min., cm	213	40	—	40	—	40	—	40	—	40	—	40	—	40	—	40
Solubility in trichloroethylene, %	214	97.5	—	97.5	—	97.5	—	97.5	—	97.5	—	97.5	—	97.5	—	97.5

^aThe demulsibility test shall be made within 30 days from date of shipment.

^bIf the particle charge for test CSS-1 and CSS-1h is inconclusive, material having a maximum pH value of 6.7 will be acceptable.

9-02.2(2) Samples

When requested by the Engineer, the asphalt supplier shall ship, by prepaid express or U.S. mail, samples of asphalt that represent current production.

9-02.3 Temperature of Asphalt

The temperature of paving asphalts in storage tanks when loaded for transporting to destination shall not be greater than 400 F.

9-02.4 Anti-Stripping Additive

When directed by the Engineer, asphalt material shall be treated with an approved heat-stable, anti-stripping additive. The anti-stripping additive shall be added to the asphalt at the point of shipment and shall be at the percentage designated by the Engineer, not to exceed 1 percent by weight of the asphalt. The anti-stripping additive shall be approved by the Materials Laboratory prior to use. Once designated for use on a specific project, the brand, grade, or percentage of anti-stripping additive shall not be changed without approval of the Engineer.

9-03 AGGREGATES**9-03.1 Aggregates for Portland Cement Concrete****9-03.1(1) General Requirements**

Portland cement concrete aggregates shall be manufactured from ledge rock, talus, or sand and gravel in accordance with the provisions of Section 3-01 and shall possess such characteristics of shape and size that concrete, resulting from a mixture of fine and coarse aggregates in the specified proportions, will be of workability which is satisfactory to the Engineer. Regardless of compliance with all other provisions of these Specifications, if the concrete is not of a workable character, or when finished does not exhibit a proper surface, either the fine or the coarse aggregate, or both, shall be rejected or altered as required by the Engineer.

If, in the judgment of the Engineer, based on previous experience or on laboratory tests, concrete aggregates from a given source are detrimentally reactive with alkalis in Portland cement, corrective measures, including use of only low alkali cement, may be required as a condition of approval.

9-03.1(2) Fine Aggregate for Portland Cement Concrete

Fine aggregate shall consist of sand or other inert materials, or combinations thereof, approved by the Engineer, having hard, strong, durable particles free from adherent coating. Fine aggregate shall be washed thoroughly to remove clay, loam, alkali, organic matter, or other deleterious matter.

9-03.1(2)A Deleterious Substances

The amount of deleterious substances in the washed aggregate shall not exceed the following values:

1. Particles of specific gravity less than 1.95 1.0 percent by weight.
2. Organic matter, by colorimetric test, shall not be darker than the reference standard color (organic plate No. 3) AASHTO T 21 unless other tests prove a darker color to be harmless.

9-03.1(2)B Grading

Fine aggregate shall be graded to conform to the following requirements expressed as percentages by weight:

Sieve Size	Class 1 Percent Passing		Class 2 Percent Passing	
	Min.	Max.	Min.	Max.
3/8" square	100		100	
U.S. No. 4	95	100	95	100
U.S. No. 8	68	86	---	---
U.S. No. 16	47	65	45	80
U.S. No. 30	27	42	---	---
U.S. No. 50	9	20	10	30
U.S. No. 100	0	7	2	10
U.S. No. 200	0	2.5	0	2.5

For fine aggregate Class 1, individual test variations under the minimum or over the maximum will be permitted as follows, provided the average of three consecutive tests is within the specification limits:

Number of Sieve	Permissible Percent of Variation in Individual Tests
U.S. No. 30 and coarser	2
U.S. No. 50 and finer	0.5

Within the gradation limits for fine aggregate Class 2, uniformity of gradation shall be limited to a range of plus or minus 0.20 of the reference fineness modulus. The reference fineness modulus shall be determined from a representative sample from the proposed source as submitted by the Contractor.

9-03.1(2)C Use of Substandard Gradings

Fine aggregate with more than the maximum percentage passing any sieve may be accepted provided the cement content of the finished concrete is increased at the Contractor's expense, $\frac{1}{3}$ percent for each 1 percent the fine aggregate passing each sieve is in excess of the maximum.

Under no circumstances shall fine aggregate Class 1 be used which has a grading finer than the following:

Sieve Size	Percent Passing
U.S. No. 8	95
U.S. No. 16	80
U.S. No. 30	60
U.S. No. 50	25
U.S. No. 200	2.5

All percentages are by weight.

9-03.1(2)D Vacant

9-03.1(3) Coarse Aggregate for Portland Cement Concrete

Coarse aggregate for Portland cement concrete shall consist of gravel, crushed stone, or other inert material or combinations thereof approved by the Engineer, having hard, strong, durable pieces free from adherent coatings. Coarse aggregate shall be washed thoroughly to remove clay, silt, bark, sticks, alkali, organic matter, or other deleterious material. When required by the Engineer, coarse aggregate shall be hand-picked to remove harmful material.

9-03.1(3)A Deleterious Substances

The amount of deleterious substances shall not exceed the following values:

Amount finer than U.S. No. 200	0.5 percent by weight
Pieces of specific gravity less than 1.95	2.0 percent by weight
Clay lumps	0.5 percent by weight
Shale	2.0 percent by weight
Wood waste	0.05 percent by weight

9-03.1(3)B Wear in Los Angeles Machine

Coarse aggregate shall not have a percentage of wear in the Los Angeles machine in excess of 35 after 500 revolutions.

9-03.1(3)C Grading

Coarse aggregate for concrete shall conform to one of the following gradings:

Sieve Size	Percent Passing							
	Grading No. 2		Grading No. 4		Grading No. 5		Grading No. 6	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
1½" square	100	---	100	---	---	---	---	---
1¼" square	95	100	90	100	---	---	---	---
1" square	---	---	---	---	100	---	---	---
¾" square	40	70	0	20	80	100	100	---
½" square	---	---	---	---	---	---	90	100
⅜" square	5	20	0	2	10	40	40	90
U.S. No. 4	0	2	---	---	0	4	5	30
U.S. No. 200	0	0.5	0	0.5	0	0.5	0	0.5

All percentages are by weight.

In tests, a variation of four under the minimum percentages will be allowed. The average of three successive tests shall be within the percentages stated above. Coarse aggregate shall contain no piece of greater size than two times the maximum sieve size for the specified grading measured along the line of greatest dimension.

When the Engineer approves, the coarse aggregate may be blended from other sizes if:

1. The resulting aggregate meets all requirements for specified grading;
2. Each size used makes up at least 5 percent of the blend; and
3. The Contractor supplies the Engineer with gradings for the proposed sizes, along with their proper proportions before producing the aggregate. If the aggregate will come from commercial sources, the Contractor shall supply this information and have it approved before proportioning and mixing the concrete.

In place of Grading No. 2, the Contractor may substitute a 50-50 mix of Gradings No. 4 and 5.

9-03.1(3)D Use of Substandard Gradings

Coarse aggregate containing more than the maximum percentage passing any sieve may be accepted provided the cement content of the finished concrete is increased at the Contractor's expense, ¼ percent for each 1 percent the amount passing each of the ¾-inch, ⅜-inch, and No. 4 sieves is in excess of the maximum. Coarse aggregate No. 2 shall not be used under any circumstances when the combined amount passing any sieve exceeds the following:

¾" square	70%
⅜" square	30%
U.S. No. 4	5%

Coarse aggregate No. 5 shall not be used under any circumstances when the combined amount passing any sieve exceeds the following:

$\frac{3}{8}$ " square	50%
U.S. No. 4	8%

9-03.1(3)E Concrete Strength Contracting Agency-Provided Mix Designs

Coarse aggregate sources for use in Contracting Agency-provided mix designs shall be qualified based on their relative strength compared to concrete aggregates from Steilacoom, Washington (WSDOT pit designation P.S. B-1). Concrete shall be made from the proposed coarse aggregate, graded to comply with the requirements of these Specifications, and combined with the specified proportions of cement and the fine aggregate proposed for use with the coarse aggregate. For aggregates to qualify for Contracting Agency-provided Class 3000 and 4000 mix designs, concrete strength at the age of 14 days shall not be less than 90 percent of that developed by concrete made from the same cement and washed sand and gravel from Steilacoom. Aggregates from the test source and from Steilacoom shall be of the same grading and the concrete shall be mixed in the same proportions and to the same consistency. For Contracting Agency-provided Class 5000, the required minimum shall be 95 percent of the concrete strength compared to the Steilacoom aggregate. For Portland cement concrete pavement, a minimum of 90 percent based on flexural strength shall be required.

The increase of cement content or the use of concrete admixtures will not be permitted for the purpose of qualifying an aggregate source.

9-03.1(4) Coarse Aggregate for Portland Cement Concrete Contractor-Provided Mix Designs

Coarse aggregate for concrete in Contractor-provided mix designs shall consist of gravel, crushed stone, or other inert material or combinations thereof having hard, strong, durable pieces free from adherent coatings. Coarse aggregate shall be washed to remove clay, silt, bark, sticks, alkali, organic matter, or other deleterious material.

9-03.1(4)A Deleterious Substances

The amount of deleterious substances shall not exceed the following values:

Amount finer than U.S. No. 200	1.00 percent by weight
Pieces of specific gravity less than 1.95	2.00 percent by weight
Clay lumps	0.50 percent by weight
Shale	2.00 percent by weight
Wood waste	0.05 percent by weight

For coarse aggregate with a minimum single face fracture content of 25 percent by weight, the material finer than the U.S. No. 200 sieve may increase to a maximum of 1.5 percent by weight. Fracture shall be determined in accordance with WSDOT Method 103 for each specification screen size U.S. No. 10 and above which retains more than 5 percent of the total sample.

9-03.1(4)B Wear in Los Angeles Machine

Coarse aggregate shall not have a percentage of wear in Los Angeles machine in excess of 35 after 500 revolutions.

9-03.1(4)C Grading

Coarse aggregate for Portland cement concrete when separated by means of laboratory sieves shall conform to one or more of the following gradings as called for elsewhere in these Specifications, Special Provisions, or in the Plans:

Passing Sieve Size	AASHTO Grading No. 467		AASHTO Grading No. 57		AASHTO Grading No. 67		AASHTO Grading No. 7		AASHTO Grading No. 8	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
2" square	100	---	---	---	---	---	---	---	---	---
1½" square	95	100	100	---	---	---	---	---	---	---
1" square	---	---	95	100	100	---	---	---	---	---
¾" square	35	70	---	---	90	100	100	---	---	---
½" square	---	---	25	60	---	---	90	100	100	---
⅜" square	10	30	---	---	20	55	40	70	85	100
U.S. No. 4	0	5	0	10	0	10	0	15	10	30
U.S. No. 8	---	---	0	5	0	5	0	5	0	10
U.S. No. 16	---	---	---	---	---	---	---	---	0	5

All percentages are by weight.

As an alternative to the AASHTO gradings, the Contractor may use WSDOT grading No. 2 and No. 5.

In individual tests, a variation of four under the minimum percentages or over the maximum percentages will be allowed. The average of three successive tests shall be within the percentages stated above. Coarse aggregate shall contain no piece of greater size than two times the maximum sieve size for the specified grading measured along the line of greatest dimension.

When the Engineer approves, the coarse aggregate may be blended from other sizes if:

1. The resulting aggregate meets all requirements for the approved grading;
2. Each size used makes up at least 5 percent of the blend; and
3. The Contractor supplies the Engineer with gradings for the proposed sizes, along with their proper proportions.

9-03.2 Vacant**9-03.3 Vacant****9-03.4 Aggregate for Bituminous Surface Treatment****9-03.4(1) General Requirements**

Aggregate for bituminous surface treatment shall be manufactured from ledge rock, talus, or gravel, in accordance with Section 3-01, which meets the following test requirements:

Los Angeles Wear, 500 Rev.
Degradation Factor

35% max.
30% min.

9-03.4(2) Grading and Quality

Aggregate for bituminous surface treatment shall conform to the requirements in the table below for grading and quality. The particular type or grading to be used shall be as shown in the Plans. All percentages are by weight.

The material shall meet the requirements for grading and quality when placed in hauling vehicles for delivery to the roadway, or during manufacture and placement into a temporary stockpile. The exact point of acceptance will be determined by the Engineer.

	Crushed Cover Stone Percent Passing	Crushed Screening Percent Passing				
		3/4"-1/2"	5/8"-3/4"	1/2"-3/4"	3/8"-#10	1/4"-0"
1" square		100				
3/4" square	100	95-100	100	---	---	---
5/8" square	95-100	---	95-100	100	---	---
1/2" square	---	0-20	---	95-100	100	---
3/8" square	---	0-5	---	---	90-100	100
1/4" square	30-50	---	0-10	0-15	50-75	90-100
U.S. No. 10	---	---	0-3	0-3	0-10	30-60
U.S. No. 200	0-7.5	0-1.0	0-1.0	0-1.0	0-1.0	0-10.0
% fracture, by weight, min.	75	75	75	75	75	75
Sand equivalent min.	40	---	---	---	---	---
Static Stripping Test	Pass	Pass	Pass	Pass	Pass	Pass

All percentages are by weight.

The fracture requirement shall be at least one fractured face and will apply to material retained on each specification sieve size No. 10 and above if that sieve retains more than 5 percent of the total sample.

The finished product shall be clean, uniform in quality, and free from wood, bark, roots, and other deleterious materials.

Crushed screenings shall be substantially free from adherent coatings. The presence of a thin, firmly adhering film of weathered rock shall not be considered as coating unless it exists on more than 50 percent of the surface area of any size between successive laboratory sieves.

The portion of aggregate for bituminous surface treatment retained on a 1/4-inch sieve shall not contain more than 0.1 percent deleterious materials by weight.

9-03.5 Vacant**9-03.6 Aggregates for Asphalt Treated Base (ATB)****9-03.6(1) General Requirements**

Aggregates for asphalt treated base shall be manufactured from ledge rock, talus, or gravel, in accordance with the provisions of Section 3-01, that meet the following test requirements:

Los Angeles Wear, 500 Rev.	30% max.
Degradation Factor	15% min.

9-03.6(2) Grading

Aggregates for asphalt treated base shall meet the following requirements for grading:

Sieve Size	Percent Passing
2" square	100
1/2" square	56-100
3/4" square	40-78
U.S. No. 10	22-57
U.S. No. 40	8-32
U.S. No. 200	2.0-9.0
Asphalt Cement, Percent of Total Mixture	2.5-4.5

(Exact percentage of asphalt to be determined by the Engineer.)

All percentages are by weight.

9-03.6(3) Test Requirements

When the aggregates are combined within the limits set forth in Section 9-03.6(2) and mixed in the laboratory with the designated grade of asphalt, the mixture shall be capable of meeting the following test values:

Stabilometer Value	30 min.
Cohesimeter Value	50 min.
Modified Lottman Stripping Test	Pass

The sand equivalent value of the mineral aggregate for asphalt treated base shall not be less than 35.

9-03.7 Vacant**9-03.8 Aggregates for Asphalt Concrete****9-03.8(1) General Requirements**

Aggregates for asphalt concrete shall be manufactured from ledge rock, talus, or gravel, in accordance with the provisions of Section 3-01. The material from which they are produced shall meet the following test requirements:

Los Angeles Wear, 500 Rev.	30% max.
Degradation Factor, Wearing Course	30% min.
Degradation Factor, Other Courses	20% min.

It shall be uniform in quality, substantially free from wood, roots, bark, extraneous materials, and adherent coatings. The presence of a thin, firmly adhering film of weathered rock will not be considered as coating unless it exists on more than 50 percent of the surface area of any size between consecutive laboratory sieves.

Aggregate removed from deposits contaminated with various types of wood waste shall be washed, processed, selected, or otherwise treated to remove sufficient wood waste so that the oven-dried material retained on a 1/4-inch square sieve shall not contain more than 0.1 percent by weight of material with a specific gravity less than 1.0.

9-03.8(2) Test Requirements

Aggregate for asphalt concrete shall meet the following test requirements:

		Class of Asphalt Concrete					
		A	B	D	E	F	G
Fracture, by weight	(See Note)	1	2	3	4	4	2
Sand Equivalent	Min.	45	45	---	45	35	45

¹The fracture requirements are at least one fractured face on 90 percent of the material retained on each specification sieve size U.S. No. 10 and above, if that sieve retains more than 5 percent of the total sample.

²The fracture requirements are at least one fractured face on 75 percent of the material retained on each specification sieve size U.S. No. 10 and above, if that sieve retains more than 5 percent of the total sample.

³The fracture requirements are at least two fractured faces on 75 percent and at least one fractured face on 90 percent of the material retained on each specification sieve, U.S. No. 8 and above, if that sieve retains more than 5 percent of the total sample.

⁴The fracture requirements are at least one fractured face on 50 percent of the material retained on each specification sieve size U.S. No. 10 and above, if that sieve retains more than 5 percent of the total sample.

When material is being produced and stockpiled for use on a specific contract or for a future contract, the fracture and sand equivalent requirements shall apply at the time of stockpiling. When material is used from a stockpile that has not been tested as provided above, the requirements for fracture and sand equivalents shall apply at the time of its introduction to the cold feed of the mixing plant.

The properties of the aggregate in a preliminary mix design for asphalt concrete shall be such that, when it is combined within the limits set forth in Section 9-03.8(6) and mixed in the laboratory with the designated grade of asphalt, mixtures with the following test values can be produced:

		Class of Asphalt Concrete					
		A	B	D	E	F	G
Stabilometer Value	Min.	37	35	---	35	35	35
Cohesimeter Value	Min.	100	100	---	100	50	100
Percent Air Voids		2-4.5	2-4.5	---	2-4.5	2-4.5	2-4.5
Modified Lottman							
Stripping Test		Pass	Pass	Pass	Pass	Pass	Pass

9-03.8(3) Grading**9-03.8(3)A Vacant****9-03.8(3)B Gradation**

The Contractor may furnish aggregates for use on the same contract from a single stockpile or from multiple stockpiles. The gradation of the aggregates shall be such that the completed mixture complies in all respects with the pertinent requirements of Section 9-03.8(6).

Acceptance of the aggregate gradation shall be based on samples taken from the final mix.

9-03.8(3)C Gradation — Recycled Asphalt Pavement and Mineral Aggregate

Asphalt concrete planings or old asphalt concrete utilized in the production of asphalt concrete shall be sized prior to entering the mixer so that a uniform and thoroughly mixed asphalt concrete is produced in the mixer. If there is evidence of the old asphalt concrete not breaking down during the heating and mixing of the asphalt concrete, the Engineer may elect to modify the maximum size entering the mixer. No contamination by deleterious materials will be allowed in the old asphalt concrete used.

The gradation for the new aggregate used in the production of the asphalt concrete shall be the responsibility of the Contractor, and when combined with recycled material, the combined material shall meet the gradation specification requirements for the specified Class ACP as listed in Section 9-03.8(6) and 9-03.8(6)A or as shown in the Special Provisions. The new aggregate shall meet the general requirements listed in Section 9-03.8(1) and shall meet the appropriate fracture and sand equivalent requirements as listed in Section 9-03.8(2).

9-03.8(4) Blending Sand

In the production of aggregate for asphalt concrete, there is often a deficiency of material passing the U.S. No. 40. When this occurs, blending sand in an amount specified by the Engineer may be used to make up this deficiency, provided that a satisfactory final mix is produced, including fracture requirements.

Blending sand shall be clean, hard, sound material, either naturally occurring sand or crusher fines, and must be material which will readily accept an asphalt coating. The exact grading requirements for the blending sand shall be such that, when it is mixed with an aggregate, the combined product shall meet the requirements of Section 9-03.8(6) for the class of material involved. Blending sand shall meet the following quality requirement:

Sand Equivalent

30 min.

Blending sand shall be tested by the Materials Laboratory before it will be approved for use.

9-03.8(5) Mineral Filler

Mineral filler, when used in ACP mix, shall conform to the requirements of AASHTO M 17.

9-03.8(6) Proportions of Materials

The materials of which asphalt concrete is composed shall be of such sizes, gradings, and quantities that, when proportioned and mixed together, they will produce a well graded mixture within the requirements listed in the table which follows.

The percentages of aggregate refers to completed dry mix, and includes mineral filler when used.

Sieve Size	Class A and B	Grading Requirements		Class F	Class G
		Class D	Class E		
		Percent Passing			
1 1/4" square	---	---	100	---	---
1" square	---	---	90-100	---	---
3/4" square	100	---	---	100	---
5/8" square	---	---	67-86	---	---
1/2" square	90-100	100	60-80	80-100	100
3/8" square	75-90	97-100	---	---	97-100
1/4" square	55-75	---	40-62	45-78	60-88
U.S. No. 4	---	30-50	---	---	---
U.S. No. 8	---	5-15	---	---	---
U.S. No. 10	30-42	---	25-40	30-50	32-53
U.S. No. 40	11-24	---	10-23	---	11-24
U.S. No. 200	3.0-7.0	2.0-5.0	2.0-9.0	2.0-8.0	3.0-7.0

For asphalt concrete Class A, B, E, F, and G produced using recycled asphalt materials and placed in areas other than the wearing course of the traveled lane, the gradation for the U.S. No. 200 sieve is revised as follows:

	Maximum Passing 0.075 mm
50%-60% Recycled Material	8.0%
61%-70% Recycled Material	9.0%

9-03.8(6)A Basis of Acceptance

- Asphalt Concrete will be accepted based on its conformance to the project job mix formula (JMF). For the determination of a project JMF, the Contractor shall submit to the Engineer, representative samples of the various aggregates to be used along with the gradation data showing the stockpile averages and variation of the aggregates as produced, together with proposed combining ratios and the average gradation of the completed mix. Based on submitted gradation and aggregates from the Contractor, the Engineer will determine the asphalt content, anti-strip requirement, and asphalt retention factor in the mix design process. Using the representative samples submitted and proposed proportion of each,

trial mix tests will be run to determine the percentage of asphalt, by weight, to be added. The JMF thus established shall be changed only upon order of the Engineer.

The intermingling of asphalt concrete mixtures produced from more than one JMF is prohibited. Each strip of asphalt concrete pavement placed during a working shift shall conform to a single job mix formula established for the class of asphalt concrete specified unless there is a need to make an adjustment in the JMF.

No mixture shall be produced for use on the project until the amount of asphalt material and anti-strip additive to be added has been established.

2. Job Mix Formula — Statistical Acceptance

The average gradation of the completed asphalt concrete mix submitted by the Contractor in the mix design proposal, as required in Section 9-03.8(6) and the resulting Mix Design Recommendations, shall be the JMF. Any change or adjustment of percentages in any constituent of the JMF creates a new JMF.

3. Job Mix Formula Tolerances and Adjustments

- a. Tolerances — Statistical Acceptance. After the JMF is determined, the several constituents of the mixture at the time of acceptance shall conform to the following tolerances:

Constituent of Mixture	Tolerance Limits
	The tolerance limit for each mix constituent shall not exceed the broad band specification limits specified in Section 9-03.8(6), except the tolerance limits for sieves designated as 100% passing will be 99-100. Broad band specification limits Section 9-03.8(6)
Aggregate passing 1", ¾", ½", ¼", and ⅜" sieves	± 6%
Aggregate passing ¼" sieve	± 5%
Aggregate passing No. 10 sieve	± 4%
Aggregate passing No. 40 sieve	± 2.0% Note 1
Aggregate passing No. 200 sieve	± 0.5% Note 2
Asphalt cement	

For open graded mix: Tolerance limits shall be for aggregate gradation only and shall be as specified in Section 9-03.8(6).

Note 1 — 2.0% if less than 50% RAP (Recycled Asphalt Pavement), 2.5% for 50% RAP or more.

Note 2 — 0.5% if less than 20% RAP, 0.7% for 20% and over RAP, but less than 50% RAP, 1.0% for 50% RAP or greater.

These tolerance limits constitute the allowable limits as described in Section 1-06.2(1).

- b. Tolerances — Nonstatistical Acceptance. After the JMF is determined, the constituents of the mixture at the time of acceptance shall conform to the range of the proportion specified in the broad band specifications of Section 9-03.8(6) for gradation and the design mix asphalt content plus or minus 0.7 percent.
- c. Adjustments
 - 1. Aggregates. Upon written request from the Contractor, the Project Engineer may approve field adjustments to the JMF a maximum of 2 percent for the aggregate retained on the No. 10 sieve and above, 1 percent for the aggregate passing the No. 10 and No. 40 sieves, and 0.5 percent for the aggregate passing the No. 200 sieve. These field adjustments to the JMF may be made by the Project Engineer provided the change will produce material of equal or better quality. The above adjustments and/or any further adjustments as ordered by the Engineer will be considered as a new JMF. Adjustments beyond these limits will require development of a new JMF. The adjusted JMF plus or minus the allowed tolerances shall be within the range of the broad band specifications.
 - 2. Asphalt Content. The Project Engineer may order or approve the Contractor's request to change asphalt content a maximum of 0.3 percent from the approved JMF. No field adjustments of the JMF relative to the asphalt cement content exceeding 0.3 percent from the initial JMF will be made without the approval of the Materials Engineer.

9-03.9 Aggregates for Ballast and Crushed Surfacing

9-03.9(1) Ballast

Ballast shall consist of crushed, partially crushed, or naturally occurring granular material from approved sources manufactured in accordance with the provisions of Section 3-01.

The material from which ballast is to be manufactured shall meet the following test requirements:

Los Angeles Wear, 500 Rev	40% max.
Degradation Factor	15% min.

Ballast shall meet the following requirements for grading and quality when placed in hauling vehicles for delivery to the roadway or during manufacture and placement into a temporary stockpile. The exact point of acceptance will be determined by the Engineer.

Sieve Size	Percent Passing
2½" square	100
2" square	65-100
1" square	50-85
¾" square	30-50
U.S. No. 40	16 max.
U.S. No. 200	9.0 max.

Dust Ratio: $\frac{\% \text{ Passing U.S. No. 200}}{\% \text{ Passing U.S. No. 40}}$ $\frac{2}{3}$ max.

Sand Equivalent 35 min.

All percentages are by weight.

The portion of ballast retained on 1/4-inch sieve shall not contain more than 0.2 percent wood waste.

9-03.9(2) Shoulder Ballast

Shoulder ballast shall meet the requirements of Section 9-03.9(1) for ballast except for the following special requirements.

The grading and quality requirements are:

Sieve Size	Percent Passing
2 1/2" square	100
3/4" square	40-80
1/4" square	5 max.
U.S. No. 100	0-2
% Fracture	75 min.

All percentages are by weight.

The sand equivalent value and dust ratio requirements do not apply.

The fracture requirement shall be at least one fractured face and will apply to material retained on each specification sieve size 1/4 inch and above if that sieve retains more than 5 percent of the total sample.

9-03.9(3) Crushed Surfacing

Crushed surfacing shall be manufactured from ledge rock, talus, or gravel in accordance with the provisions of Section 3-01. The materials shall be uniform in quality and substantially free from wood, roots, bark, and other extraneous material and shall meet the following test requirements:

Los Angeles Wear, 500 Rev.	35% max.
Degradation Factor — Top Course	25% min.
Degradation Factor — Base Course	15% min.

Crushed surfacing of the various classes shall meet the following requirements for grading and quality when placed in hauling vehicles for delivery to the roadway, or during manufacture and placement into a temporary stockpile. The exact point of acceptance will be determined by the Engineer.

Sieve Size	Base Course Percent Passing	Top Course and Keystone
1 1/4" square	100	
3/4" square		100
5/8" square	50-80	
1/4" square	30-50	55-75
U.S. No. 40	3-18	8-24
U.S. No. 200	7.5 max.	10.0 max.
% Fracture	75 min.	75 min.
Sand Equivalent	40 min.	40 min.

All percentages are by weight.

The fracture requirement shall be at least one fractured face and will apply to material retained on each specification sieve size U.S. No. 10 and above if that sieve retains more than 5 percent of the total sample.

The portion of crushed surfacing retained on a 1/4-inch sieve shall not contain more than 0.15 percent wood waste.

9-03.9(4) Maintenance Rock

Maintenance rock shall meet all requirements of Section 9-03.9(3) for crushed surfacing top course except that it shall meet the following specifications for grading:

Sieve Size	Percent Passing
1/2" square	100
1/4" square	55-70
U.S. No. 40	10-25
U.S. No. 200	7 max.

All percentages are by weight.

9-03.10 Aggregate for Gravel Base

Gravel base shall consist of granular material, either naturally occurring or processed. It shall be essentially free from various types of wood waste or other extraneous or objectionable materials. It shall have such characteristics of size and shape that it will compact readily and shall meet the following test requirements:

Stabilometer "R" Value	72 min.
Swell pressure	0.3 psi max.

The maximum particle size shall not exceed 2/3 of the depth of the layer being placed.

Gravel base shall meet the following requirements for grading and quality when placed in hauling vehicles for delivery to the roadway or during manufacture and placement into a temporary stockpile. The exact point of acceptance will be determined by the Engineer.

Sieve Size	Percent Passing
1/4" square	25 min.
U.S. No. 200	10.0 max.
Dust Ratio: $\frac{\% \text{ Passing U.S. No. 200}}{\% \text{ Passing U.S. No. 40}}$	3/4 max.
Sand Equivalent	30 min.

All percentages are by weight.

Gravel base material retained on a 1/4-inch sieve shall contain not more than 0.20 percent by weight of wood waste.

9-03.11 Recycled Portland Cement Concrete Rubble

Recycled Portland cement concrete rubble may be used as, or blended with: ballast; shoulder ballast; crushed surfacing base and top course; maintenance rock; gravel backfill for foundation, walls, and pipe bedding; gravel borrow; bedding material for rigid pipe and flexible pipe; and foundation material Class A, B, and C.

A preliminary sample of the recycled concrete, and native material if any, used for ballast, shoulder ballast, crushed surfacing base and top course, maintenance rock, and gravel backfill for foundation Class A shall be submitted for testing for LA Wear and Degradation Factor. In addition, the source of any native material that may be blended with the recycled Portland cement concrete rubble shall also meet the specifications for LA Wear and Degradation Factor for the type aggregate being used.

A maximum of 20 percent by weight of recycled asphalt concrete pavement may be used in the blended product. The asphalt concrete content is calculated as the amount of asphalt particles retained on all screens 1/4 inch and above.

The recycled aggregates shall be stockpiled in such a manner that each certified test report will identify a single stockpile of not more than 10,000 tons.

The Contractor shall certify that the recycled material is neither hazardous or toxic. This certification shall address the toxicity characteristics prescribed in WAC 173-303-090(8) under sampling and testing according to WAC 173-303-110. Sampling and testing shall be one per 10,000 tons from any single source and not less than one sample from any single source.

Acceptance of the recycled concrete rubble aggregate for hazardous and toxic requirements shall be by Manufacturer's Certificate of Compliance with accompanying test reports.

Gradation, sand equivalent, and fracture requirements will be per the specific product outlined in these specifications.

9-03.12 Gravel Backfill

Gravel backfill shall consist of crushed, partially crushed, or naturally occurring granular material produced in accordance with the provisions of Section 3-01.

9-03.12(1) Gravel Backfill for Foundations

9-03.12(1)A Class A

Gravel backfill for foundations, Class A, shall conform to the requirements of Section 9-03.9 for ballast or 9-03.9(3) for crushed surfacing base course.

9-03.12(1)B Class B

Gravel backfill for foundations, Class B, shall conform to the requirements of Section 9-03.10 except that the requirements for stabilometer R value and swell pressure do not apply.

9-03.12(2) Gravel Backfill for Walls

Gravel backfill for walls shall consist of free draining granular material, essentially free from various types of wood waste or other extraneous or objectionable materials. It shall meet the following requirements for grading and quality when placed in hauling vehicles for delivery to the roadway or during manufacture and placement into a temporary stockpile. The exact point of acceptance will be determined by the Engineer.

Sieve Size	Percent Passing
4" square	100
1/4" square	25-70
U.S. No. 200	5.0 max.
Dust Ratio: $\frac{\% \text{ Passing U.S. No. 200}}{\% \text{ Passing U.S. No. 40}}$	3/4 max.
Sand Equivalent	60 min.

All percentages are by weight.

That portion of the material retained on a 1/4-inch square opening shall contain not more than 0.20 percent by weight of wood waste.

9-03.12(3) Gravel Backfill for Pipe Zone Bedding

Gravel backfill for pipe zone bedding shall consist of crushed, processed, or naturally occurring granular material. It shall be essentially free from various types of wood waste or other extraneous or objectionable materials. It shall have such characteristics of size and shape that it will compact readily and shall meet the following specifications for grading and quality:

Sieve Size	Percent Passing
1" square	100
1/4" square	25-80
U.S. No. 200	15.0 max.*
Sand Equivalent	35 min.

*5.0 max. for sanitary sewer installations.

All percentages are by weight.

9-03.12(4) Gravel Backfill for Drains

Gravel backfill for drains shall meet the requirements for coarse aggregate for Portland cement concrete, Grading No. 5 as listed in Section 9-03.1(3)C, with the additional requirement that the percent by weight passing the U.S. No. 200 sieve shall not be greater than 2.0 percent.

9-03.13 Backfill for Sand Drains

Backfill for sand drains shall conform to the following grading:

Sieve Size	Percent Passing
1/2" square	90-100
1/4" square	65-100
U.S. No. 10	40-100
U.S. No. 50	3-30
U.S. No. 100	0-4
U.S. No. 200	0-3.0

All percentages are by weight.

9-03.13(1) Sand Drainage Blanket

Aggregate for the sand drainage blanket shall consist of granular material, free from wood, bark, or other extraneous material and shall meet the following requirements for grading:

Sieve Size	Percent Passing
2 1/2" square	90-100
1/4" square	30-100
The portion passing 1/4" shall meet the following requirements for grading:	
U.S. No. 10	50-100
U.S. No. 50	0-30
U.S. No. 100	0-7.0
U.S. No. 200	0-3.0

All percentages are by weight.

That portion of backfill for sand drains and sand drainage blanket retained on a 1/4-inch sieve shall contain not more than 0.05 percent by weight of wood waste.

9-03.14 Borrow**9-03.14(1) Gravel Borrow**

Aggregate for gravel borrow shall consist of granular material, either naturally occurring or processed, and shall meet the following requirements for grading and quality:

Sieve Size	Percent Passing
4" square ¹	100
U.S. No. 4	50-90
U.S. No. 40	30 max.
U.S. No. 200	7.0 max.
Sand Equivalent	50 min.

All percentages are by weight.

¹For geosynthetic reinforced walls or slopes, the maximum particle size shall be limited to 1 1/4 inches.

9-03.14(2) Select Borrow

Material for select borrow shall consist of granular material, either naturally occurring or processed, and shall meet the following requirements for grading and quality:

Sieve Size	Percent Passing
6" square ^{1,2}	100
U.S. No. 40	50 max.
U.S. No. 200	10.0 max.
Sand Equivalent	15 min.

All percentages are by weight.

¹For geosynthetic reinforced slopes, the maximum particle shall be limited to 1½ inches.

²The maximum particle size shall be limited to 4 inches when select borrow is used in the top 2 feet of embankments or where Method C compaction is required.

9-03.14(3) Common Borrow

Material for common borrow shall consist of granular or nongranular soil and/or aggregate which is free of deleterious material and is nonplastic.

Deleterious material includes wood, organic waste, coal, charcoal, or any other extraneous or objectionable material.

The material shall be considered nonplastic if the percent by weight passing the U.S. No. 200 sieve does not exceed 15 percent, or if the soil fraction passing the U.S. No. 40 sieve cannot be rolled, at any moisture content, into a thread as prescribed in Section 4 of AASHTO Standard Test Designation T 90. If requested by the Contractor, the plasticity may be increased with the approval of the Engineer if it is determined that an increased plasticity will be satisfactory for the specified embankment construction.

The material shall not contain more than 3 percent organic material by weight.

9-03.15 Bedding Material for Rigid Pipe

Bedding material for rigid pipe shall meet the requirements of Section 9-03.12(3) except the percent passing the U.S. No. 200 sieve shall be 7 percent maximum.

If, in the opinion of the Engineer, the native granular material is free from wood waste, organic material, and other extraneous or objectionable materials, it may be used for pipe bedding. The material shall have a maximum dimension of 1½ inches.

9-03.16 Bedding Material for Thermoplastic Pipe

Bedding material for thermoplastic pipe shall be clean sand/gravel mixture free from organic matter and conforming to the following gradation:

Sieve Size	Percent Passing
3/4" square	100
3/8" square	70-100
U.S. No. 4	55-100
U.S. No. 10	35-95
U.S. No. 20	20-80
U.S. No. 40	10-55
U.S. No. 100	0-10
U.S. No. 200	0-3

All percentages are by weight.

9-03.17 Foundation Material Class A and Class B

Foundation material Class A and Class B shall conform to the following gradations:

Sieve Size	Percent Passing	
	Class A	Class B
2 1/2" square	98-100	95-100
2" square	92-100	75-100
1 1/2" square	72-87	30-60
1 1/4" square	58-75	0-15
3/4" square	27-47	0-1
3/8" square	3-14	---
U.S. No. 4	0-1	---

All percentages are by weight.

9-03.18 Foundation Material Class C

Foundation material Class C shall consist of clean bank run sand and gravel, free from dirt, roots, topsoil, and debris and contain not less than 35 percent retained on a 1/4-inch sieve and with all stones larger than 2 inches in the longest dimension removed.

9-03.19 Bank Run Gravel for Trench Backfill

Trench backfill material shall consist of aggregate for gravel base, as specified in Section 9-03.10, excepting however, that 100 percent of the material shall pass a 2 1/2-inch opening.

9-03.20 Test Methods for Aggregates

The properties enumerated in these Specifications shall be determined in accordance with the following methods of test:

Title	Test Method
Sampling	AASHTO T 2
Organic Impurities	AASHTO T 21
Clay Lumps in Aggregates	AASHTO T 112
Abrasion of Coarse Aggregates by Use of the Los Angeles Machine	WSDOT No. 101
Material Finer than U.S. No. 200 Sieve in Aggregates	WSDOT No. 102
Percent of Fracture in Aggregates	WSDOT No. 103
Sieve Analysis of Fine and Coarse Aggregates	WSDOT No. 104
Sand Equivalent Test for Surfacing Materials	WSDOT No. 109
Determination of Degradation Value	WSDOT No. 113
Determination of Fineness Modulus	WSDOT No. 119
Lightweight Pieces in Aggregates	WSDOT No. 122
Percentage of Particles Smaller than 0.075 mm and 0.005 mm	WSDOT No. 603
Stabilometer R Value, Untreated Materials	WSDOT No. 611
Swell Pressure and Permeability	WSDOT No. 611
Stabilometer S Value, Treated Materials	WSDOT No. 703
Gradation of Aggregates in ACP	WSDOT No. 711
Determining Stripping of Asphalt Concrete	WSDOT No. 718
Cohesimeter	WSDOT No. 719
Compressive Strength of Concrete	WSDOT No. 801
Flexural Strength of Concrete	WSDOT No. 802

9-03.21 Recycled Material**9-03.21(1) Reclaimed Glass (Mixed Waste Cullet) Additive to Aggregates**

Reclaimed glass may be blended with the following:

Ballast	9-03.9(1)
Shoulder Ballast	9-03.9(2)
Crushed Surfacing Base Course	9-03.9(3)
Aggregate for Gravel Base	9-03.10
Gravel Backfill for Foundations, Class A	9-03.12(1)A
Gravel Backfill for Foundations, Class B	9-03.12(1)B
Gravel Backfill for Walls	9-03.12(2)
Gravel Backfill for Pipe Bedding	9-03.12(3)
Gravel Backfill for Drains	9-03.12(4)
Backfill for Sand Drains	9-03.13
Sand Drainage Blanket	9-03.13(1)
Gravel Borrow	9-03.14
Bedding Material for Rigid Pipe	9-03.15
Bedding Material for Flexible Pipe	9-03.16
Foundation Material Class A and B	9-03.17
Foundation Material Class C	9-03.18
Bank Run Gravel for Trench Backfill	9-03.19

Aggregates containing reclaimed glass shall conform to the requirements of these Specifications for each item listed above. No aggregate shall contain more than 15 percent glass. No more than 10 percent of the material retained on an individual sieve $\frac{1}{4}$ -inch or larger shall be glass, based upon visual examination and weight.

9-03.21(2) Recycled Glass Aggregate

Aggregate composed solely of glass may be used as gravel backfill for walls, pipe bedding, and sand drains; sand drainage blanket; gravel borrow; and bedding material for flexible pipe.

One hundred percent of the glass shall pass a $\frac{3}{4}$ -inch square sieve and not more than 5 percent by weight shall pass a U.S. No. 200 sieve. Sieve analysis shall be conducted according to WSDOT Test Method 103-C on at least a quarterly basis by the product supplier. All test results shall be kept on file by the product supplier.

The maximum debris level shall be 10 percent. Debris is defined as any deleterious material which impacts the performance of the engineered fill and includes all non-glass constituents of the glass feed stock. The percentage of debris in cullet shall be quantified using the following visual method. Approximately 200 grams of processed cullet shall be placed in a flat pan or plate. The percentage of debris shall be estimated using AGI Data Sheets 15.1 and 15.2 "Comparison Charts for Estimating Percentage Composition," by the American Geological Institute, 1982.

Total lead content testing shall be performed quarterly by the product supplier. Tests shall include a minimum of 5 samples. Sample collection shall be conducted according to ASTM D 75. The mean of these tests shall not exceed 80 ppm. Total lead content testing will be conducted according to the EPA Method 3010/6010. All test results shall be kept on file by the product supplier.

9-04 JOINT AND CRACK SEALING MATERIALS**9-04.1 Premolded Joint Fillers****9-04.1(1) Asphalt Filler for Contraction and Longitudinal Joints in Concrete Pavements**

Premolded joint filler for use in contraction and longitudinal joints shall be $\frac{1}{8}$ inch in thickness and shall consist of a suitable asphalt mastic encased in asphalt-saturated paper or asphalt-saturated felt. It shall be sufficiently rigid for easy installation in summer months and not too brittle for handling in cool weather. It shall meet the following test requirements:

When a strip 2 inches wide and 24 inches long is freely supported 2 inches from each end and maintained at a temperature of 70 F, it shall support a weight of 100 grams placed at the center of the strip without deflecting downward from a horizontal position more than 2 inches within a period of 5 minutes.

9-04.1(2) Premolded Joint Filler for Expansion Joints

Premolded joint filler for use in expansion (through) joints shall conform to the specifications for "Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction," AASHTO M 213, except the requirement for water absorption which is deleted.

9-04.1(3) Vacant**9-04.1(4) Elastomeric Expansion Joint Seals**

Premolded elastomeric expansion joint seals shall conform to the requirements of AASHTO M 220 and shall be formed by an extrusion process with uniform dimensions and smooth exterior surfaces. The cross-section of the seal shall be shaped to allow adequate compressed width of the seal, as approved by the Engineer.

9-04.2 Joint Sealants**9-04.2(1) Hot Poured Joint Sealants**

Hot poured joint sealants shall meet the requirements of AASHTO M 173 Concrete Joint Sealer, Hot Poured Elastic Type and be sampled in accordance with ASTM D 5167. In addition, the sealant shall have a C.O.C. Flash Point (AASHTO T 48) of 205°C minimum. In lieu of the specified bond test in M 173, the bond test shall be in accordance with WSDOT Test Method 412.

9-04.2(2) Two Component Poured Rubber Joint Sealer

The physical properties of the joint sealer, when mixed in accordance with the manufacturer's recommendations, shall be as follows:

1. Color: Gray or black.
- 2.¹ Viscosity: Must be pourable and self-leveling at 50 F.
- 3.¹ Application Life: Not less than 3 hours at 72 F and 50 percent relative humidity.
4. Set to Touch: Not more than 24 hours at 72 F and 50 percent relative humidity.
5. Curing Time: Not more than 96 hours at 72 F and 50 percent relative humidity.
6. NonVolatile Content: Not less than 92 percent.

7. Hardness Rating (Durometer "Shore A"): 5-35.
8. Resiliency: Not less than 80 percent.
9. Bond test methods shall be in accordance with WSDOT Test Method No. 412.
¹Viscosity and application life may be waived providing the material is mixed and placed by a pump and mixer approved by the Engineer.

Suitable primer, if required by the manufacturer, shall be furnished with each joint sealer. The primer shall be suitable for brush or spray application at 50 F or higher and shall cure sufficiently at 50 F to pour the joint within 24 hours. It shall be considered as an integral part of the sealer system. Any failure of the sealer in the test described herein, attributable to the primer, shall be grounds for rejection or re-testing of the sealer.

Acceptance of joint sealing compound for use on a project shall be on the basis of laboratory tests of samples representative of each batch of material to be used on the job. A period of at least two weeks shall be allowed for completion of tests. Each container of the compound shall be clearly identified as to batch number.

9-04.3 Joint Mortar

Mortar for hand-mortared joints in pipes shall be made in the proportions as given in Section 7-02.3(1)A2.

Cement shall conform to the requirements of AASHTO M 85, Type I or Type II.

Sand shall conform to the requirements of AASHTO M 45.

Water shall conform to the requirements of Section 9-25.1.

9-04.4 Rubber Gaskets

9-04.4(1) Rubber Gaskets for Concrete Pipes and Precast Manholes

Rubber gaskets for use in joints of concrete culvert or storm sewer pipe and precast manhole sections shall conform to the applicable requirements of AASHTO M 198.

9-04.4(2) Vacant

9-04.4(3) Rubber Gaskets for Aluminum or Steel Culvert or Storm Sewer Pipe

Gaskets for use with metal culvert or storm sewer pipe shall be continuous closed cell, synthetic expanded rubber gaskets conforming to the requirements of ASTM D 1056, Grade 2B3.

9-04.4(4) Rubber Gaskets for Aluminum or Steel Drain Pipe

Gaskets for metal drain pipe shall be self-adhering, butyl-based, scrim-supported type. The gaskets shall be as described in the Standard Plan when specified.

9-04.4(5) Protection and Storage

Rubber gasket material shall be stored in a clean, cool place, protected from sunlight and contaminants. They shall be protected from direct sunlight at all times except during actual installation. Pipes with gaskets affixed shall be installed in the line within 28 days.

WSDOT Test Method No. 113

Method of Test for Determination of Degradation Value

1. SCOPE

- a. This method covers procedures for determining the quality of fines produced by self-abrasion of aggregate in the presence of water.

2. APPARATUS

- a. Balance — 2000 g capacity, sensitive to 1 g.
- b. Sieve Shaker — With 44.45 mm (1½ in.) throw on cam at 300 ± 5 oscillations per minute.
- c. Plastic Canister — 190.5 mm (7½ in.) diameter \times 152.4 mm (6 in.) high.
- d. Sand equivalent graduated cylinders.
- e. Sand equivalent stock solutions.
- f. Sieves — 2.00 mm (U.S. No. 10) and 0.075 mm (U.S. No. 200) sieves.
- g. Graduates — 500 ml tall form, 10 ml.
- h. Interval timer.

3. PROCEDURE

- a. Crush the material to be tested to pass the 12.5 mm sieve (½ in.), wash over a 2.00 mm sieve (U.S. No. 10) and dry to constant weight.
- b. 1000 g sample of the aggregate graded as follows:

12.5 mm (½ in.) – 6.3 mm (¼ in.)	500 g
6.3 mm – 2.00 mm (¾ in.) sieve (U.S. No. 10)	500 g
- c. Place sample in the plastic canister, add 200 cc of water, cover tightly and place in sieve shaker.
- d. Agitate the material for 20 minutes.
- e. Empty the canister into nested 2.00 mm (U.S. No. 10) and 0.075 mm (U.S. No. 200) sieves placed in a funnel over a 500 ml graduate to catch all the water.
- f. Wash out the canister and continue to wash the aggregate with fresh water until wash water is the graduate is filled to the 500 ml mark. (The aggregate may drain 50 to 100 ml of water after washing has been stopped.)
- g. Pour 7 ml of sand equivalent stock solution into a sand equivalent cylinder.
- h. Bring all solids in the graduate into suspension by capping the graduate with the palm of the hand and turning it upside down and back as rapidly as possible about 10 times.
- i. Immediately decant into the sand equivalent cylinder to the 381 mm (15 in.) mark and insert stopper in the cylinder.
- j. Mix the contents of the cylinder by alternately turning the cylinder upside down and right side up, allowing the bubble to traverse from end to end. Repeat this cycle 20 times in approximately 35 seconds.

- k. Place the cylinder on the table, remove stopper, and start timer. After 20 minutes read and record the height of the sediment column to the nearest 2.0 mm (0.1 in.).

4. CALCULATIONS

- a. Calculate the degradation factor by the following formula:

$$D = \frac{(15 - H)}{(15 + 1.75H)} \times 100$$

Where:

D = Degradation Factor

H = Height of Sediment in Tube

- b. Values may range from 0 to 100, with high values being best materials. The formula places doubtful materials at about the mid-point of the scale, with poor ones below, and good ones above that point.

Table 1: Degradation Value "D"

$$D = \frac{(15 - H)}{(15 + 1.75H)} \times 100$$

H	D	H	D	H	D	H	D	H	D
0.0	100	3.1	58	6.1	35	9.1	19	12.1	8
0.1	98	3.2	57	6.2	34	9.2	19	12.2	8
0.2	96	3.3	56	6.3	33	9.3	18	12.3	7
0.3	95	3.4	55	6.4	33	9.4	18	12.4	7
0.4	93	3.5	54	6.5	32	9.5	17	12.5	7
0.5	91	3.6	54	6.6	32	9.6	17	12.6	6
0.6	90	3.7	53	6.7	31	9.7	17	12.7	6
0.7	88	3.8	52	6.8	30	9.8	16	12.8	6
0.8	87	3.9	51	6.9	30	9.9	16	12.9	6
0.9	85	4.0	50	7.0	29	10.0	15	13.0	5
1.0	84								
1.1	82	4.1	49	7.1	29	10.1	15	13.1	5
1.2	81	4.2	48	7.2	28	10.2	15	13.2	5
1.3	79	4.3	48	7.3	28	10.3	14	13.3	4
1.4	78	4.4	47	7.4	27	10.4	14	13.4	4
1.5	77	4.5	46	7.5	27	10.5	13	13.5	4
1.6	75	4.6	45	7.6	26	10.6	13	13.6	4
1.7	74	4.7	44	7.7	26	10.7	13	13.7	3
1.8	73	4.8	44	7.8	25	10.8	12	13.8	3
1.9	71	4.9	43	7.9	25	10.9	12	13.9	3
2.0	70	5.0	42	8.0	24	11.0	12	14.0	3
2.1	69	5.1	41	8.1	24	11.1	11	14.1	2
2.2	68	5.2	41	8.2	23	11.2	11	14.2	2
2.3	67	5.3	40	8.3	23	11.3	11	14.3	2
2.4	66	5.4	39	8.4	22	11.4	10	14.4	1
2.5	65	5.5	39	8.5	22	11.5	10	14.5	1
2.6	63	5.6	38	8.6	21	11.6	10	14.6	1
2.7	62	5.7	37	8.7	21	11.7	9	14.7	1
2.8	61	5.8	37	8.8	20	11.8	9	14.8	0
2.9	60	5.9	36	8.9	20	11.9	9	14.9	0
3.0	59	6.0	35	9.0	20	12.0	8	15.0	0

WSDOT Test Method No. 606

Method of Test for Compaction Control of Granular Materials

1. SCOPE

- a. This test method consists of three separate tests which present a method for establishing the proper maximum density values to be used for controlling the compaction of granular materials. These methods account for variations of maximum obtainable density of a given material for a given compactive effort, due to fluctuations in gradation.
- b. By splitting the material on the 4.75 mm (U.S. No. 4) sieve and determining the specific gravity, the compacted density, and the loose density of each of the two fractions, a curve of maximum density versus percent passing the 4.75 mm (U.S. No. 4) sieve can be plotted. These curve values will correlate closely with the densities obtained in the field; using modern compaction equipment.
- c. The test methods are applicable either to specifications requiring compacting to a given percentage of maximum density, or to specifications requiring compaction to a given compaction ratio.
- d. Use of these test methods eliminates the danger of applying the wrong "Standard" to compaction control of gravelly soils.
- e. This test method is applicable for granular materials with more than 30 percent retained on the 4.75 mm (U.S. No. 4) sieve.

Test No. 1

(Fine Fraction-100 Percent Passing 4.75 mm (U.S. No. 4) Sieve)

1.1 SCOPE

- a. This test was developed for the sandy, non-plastic, highly permeable soils which normally occur as the fine fraction of granular base course and surfacing materials.
- b. When the fine fraction is primarily a soil having some plasticity and low permeability, AASHTO T 99 (Standard Proctor Test) may be used. With border-line soils, both tests should be applied and the one yielding the highest density value should be used

1.2 EQUIPMENT

- a. Vibratory, Spring Load Compactor (Figures 1 and 2) — Specifications for vibratory spring load compactor can be obtained from the FOSSC Materials Lab.
- b. Mold — Molds of the above dimensions can be fabricated from standard cold drawn-seamless piles or tubes. The small button at the center of the small mold follower is a measuring point. The height of this button should be adjusted so the machine follower does not bear on it during compaction. See Figure 3 for mold dimensions.
- c. Mold Piston — A piston which has a diameter of 150 mm \pm (5 $\frac{1}{8}$ in.).
- d. Height-Measuring Device — A scale with an accuracy of 0.025 mm (0.001 in.).
- e. Tamping Hammer — As specified in AASHTO T 99, Section 2.21.
- f. Sieve — 4.75 mm sieve (U.S. No. 4).
- g. Oven — Capable of maintaining a temperature of 110 \pm 5° C (230° \pm 5°F) for drying moisture samples.

- h. Balance — A balance having a capacity of 45 kg (100 lbs.) and an accuracy of 50 g (0.1 lbs.).
- i. Tamping Rod — 16 mm ($\frac{5}{8}$ in.) spherical end.

1.3 PROCEDURE

- a. Oven-dry the total original sample at a temperature not to exceed 60°C (140°F).
- b. Obtain tare weight of mold and bottom plate, record weight (mass) to the nearest 5 g (0.01 lb.).
- c. Separate the sample, by screening, into two fractions divided on the 4.75 mm (U.S. No. 4) sieve. The fraction passing the sieve is used in this test and the fraction retained will be used in Test No. 2.
- d. From the fine fraction (4.75 mm (U.S. No. 4) minus) split or otherwise obtain a representative sample of approximately 6 kg (13 lbs.). (This mass can be adjusted after the first compaction run to yield a final compacted sample approximately 150 mm (6 in.) high.)
- e. Add water to the sample (the sample should be completely and thoroughly mixed) until it is saturated when compacted. Note that the moisture content should be adjusted so that free water will show at the base of the mold between 227 kg (500 lbs.) and 908 kg (2,000 lbs.). (See Section 1.3h.) Most materials will yield the highest density at that moisture content. Some materials may continue to gain density on increasing the moisture above that specified; however, severe washing-out of the fines will occur, which will alter the character of the sample and void the test results.

Note: "Free water" is classified as a drop or two of water.

- f. Place the sample in the mold in three layers. Rod each layer 25 times and tamp with 25 blows of the tamping hammer. The blows of the hammer should produce a 305 mm (12 in.) free fall provided severe displacement of the sample does not occur. In such cases, adjust the blow strength to produce maximum compaction. The surface of the top layer should be finished as level as possible.

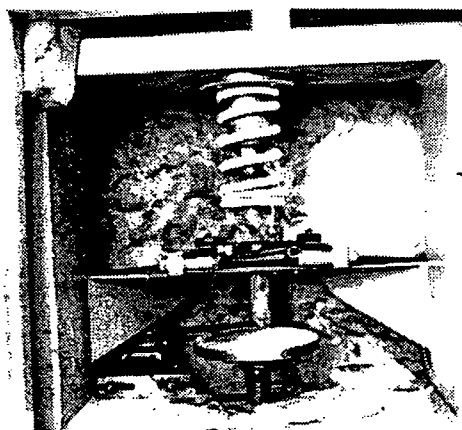


Figure 1

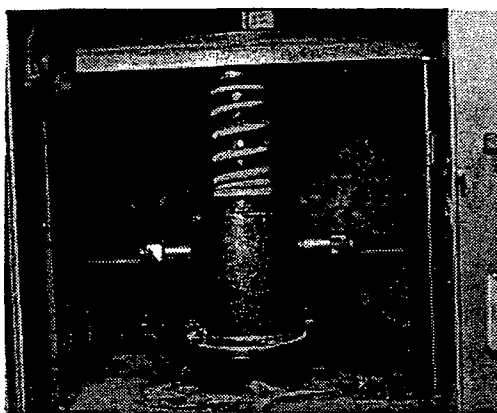


Figure 2

- g. Place the piston on top of the sample in the mold, and mount the mold on the jack in the compactor. Elevate mold with the jack until the load-spring retainer seats on top of the piston. Apply initial seating load of about 45 kg (100 lbs.) on the sample.
- h. Start the compactor hammers and, at the same time, gradually increase the spring load on the sample to 908 kg (2,000 lbs.) by elevating the jack. The rate of load application is as follows:

Load in kg (lbs)	Time in Minutes
0 to 227 (0 to 500 lbs.)	1
227 to 454 (500 lbs. to 1,000 lbs.)	½
454 to 908 (1,000 lbs. to 2,000 lbs.)	½

- i. After reaching 908 kg (2,000 lbs.), stop the hammers, release the jack, and return to zero pressure.
- j. Repeat step h. four additional times. After the last run, remove the mold from the compactor.
- k. Measure and record the height of the compacted sample to the nearest .025 mm (0.001 in.) and calculate the volume (see Section 1.4)
- l. Remove the sample from the mold, weigh it, and record its mass (weight) to the nearest 5 g (0.01 lbs.), and calculate the wet density.
- m. Vertically slice through the center of the sample, take a representative sample (at least 500 g (1.1 lbs.)) of the materials from one of the cut faces, weigh immediately, dry and determine, and record the moisture content. Calculate and record the dry density.
- n. Repeat steps d. through m. at higher or lower moisture contents, on fresh samples if needed, to obtain the maximum density value for the material, three tests are usually sufficient.

1.4 CALCULATIONS

- a. The formula for calculating the volume and dry and wet densities are as follows:

$$V = \frac{(H_1 - H_2)(B)}{1728}$$

H_1 = Inside height of the mold, mm.

H_2 = Height from top of the sample to the top of the mold, mm.

B = Inside bottom area of the mold, mm².

$$\text{Wet Density} = \frac{\text{Wet Mass (Weight)}}{\text{Volume in m}^3(\text{ft.}^3)}$$

$$\text{Dry Density} = \frac{\text{Wet Density}}{1 + \text{Moisture Content} \%}$$

***Note:** See AASHTO T 255-92 "Total Moisture Content of Aggregate by Drying," for moisture content calculations.

Test No. 2

(Coarse Fraction-0 Percent Passing 4.75 mm (U.S. No. 4) Sieve)

2.1 SCOPE

- a. This test involves two separate procedures based on the maximum size of the aggregate being tested. When the maximum size is 19 mm ($\frac{3}{8}$ in.) or less, a 0.0028 m³ (0.1 ft.³) sample size is satisfactory. For material having a maximum size of 25 to 76 mm (1 to 3 in.), the sample size should be increased to 0.014 m³ ($\frac{1}{2}$ ft.³) for accuracy. Remove any 76 mm (3 in.) plus material before proceeding with the test.

Procedure 1

(Aggregate Size: 19 mm or ($\frac{3}{8}$ in.) Less)

2.2 EQUIPMENT

- a. The equipment for this test is the same as that used in Test No. 1

2.3 PROCEDURE

- a. From the coarse fraction obtained in Test No. 1, Section 1.3(C), separate a representative sample of 4.5 to 5 kg (10 to 11 lbs.) and weigh to 5 g (0.01 lbs.).
- b. Dampen the sample to 2½% moisture and place it in a 0.0028 m³ (0.1 ft.³) mold, in three lifts. Tamp each lift lightly to consolidate the material to achieve a level surface. Omit rodding. Avoid loss of the material during placement.
- c. Place the piston on top of the sample, in the mold, and follow the procedure described in Test No. 1, Sections 1.3g. through 1.3k.
- d. Using the original dry weight value, calculate the dry density in kg/m³. Use the formula for dry density described in Test No. 1, Section 1.4.

Procedure 2

(Aggregate Size: Larger than 19 mm ($\frac{3}{8}$ in.))

2.4 EQUIPMENT

- a. 0.014 m³ ($\frac{1}{2}$ ft.³) standard aggregate measure.
- b. A metal piston having a diameter 3 mm ($\frac{1}{8}$ in.) less than the inside diameter of the 0.014 m³ ($\frac{1}{2}$ ft.³) measure.

2.5 PROCEDURE

- a. From the coarse fraction in Test No. 1, Section 1.3c., separate a representative sample of 20 kg (45 lb.) and weigh to 50 g (0.1 lb.).
- b. Split the sample into five representative and approximately equal parts
- c. Place the sample in the mold in five separate lifts. After each lift is placed in the mold, position the piston on the sample, mount the mold in the compactor, and compact as described in Test No. 1, Section 1.3h. Spacers between the load spring and piston must be used to adjust the elevation of the mold to the height of the lift being compacted.
- d. After the final lift is compacted, remove the mold from the compactor, determine the height of the compacted sample, and calculate the volume (see Test No. 1, Section 1.4(A)).
- e. Calculate the dry density in kg/m³ (lbs./ft.³) (see Test No. 1, Section 1.4(A)).

Test No. 3

Specific Gravity Determination for Maximum Density Test

3.1 EQUIPMENT

- a. Volumetric flask having a capacity of at least 100 ml or a stoppered bottle having a capacity of at least 50 ml.
- b. One vacuum pump or aspirator (pressure not to exceed 100 mm mercury).
- c. One balance accurate to 0.1 g.

3.2 MATERIAL

- a. Fine fraction 4.75 mm (U.S. No. 4) minus 500 g (1.1 lbs.) minimum.
- b. Coarse fraction 4.75 mm (U.S. No. 4) plus 1,000 g (2.2 lbs.) minimum.

3.3 PROCEDURE

- a. Place dry material, either fine or coarse fraction, in pycnometer, add water. Put pycnometer jar top in place and connect to vacuum apparatus. Apply vacuum for at least 20 minutes until air is removed from sample. Slight agitation of the jar at this time will aid the de-airing process. If the material boils too vigorously, reduce the vacuum. Remove vacuum apparatus, fill pycnometer with water, dry outside of jar carefully and weigh. Water temperature during test should be maintained as close to 20°C (68°F) as possible.

Calculate Specific Gravity as follows:

$$\text{Sp. Gr.} = \frac{a}{a + b - c}$$

Where

a = Weight of dry material, grams

b = Weight of pycnometer + water, grams

c = Weight of pycnometer + material + water, grams

3.4 REPORTS

- a. All test results are recorded on the maximum density work sheet. A copy of the maximum density work sheet is shown in Figure 3.
- b. The four separate test values determined above are all the data necessary to determine the coordinates required for construction of a maximum density curve, see Figure 4. The end points of the curve are the densities determined from tests number 1 and 2. The four intermediate points are determined through the aid of an appropriate computer program. The input to the computer consists of those values on the work sheet numbered A through D; the output, a recapitulation of input plus coordinates of the above mentioned four points. To construct the density curve, the points are plotted and a line connecting the points is drawn using a number 50 ships curve. The correctly shaped density curve is obtained by using the number 50 curve, concave side up, curved end to the outside, with a short, connecting curve.

4:P:DP/MM

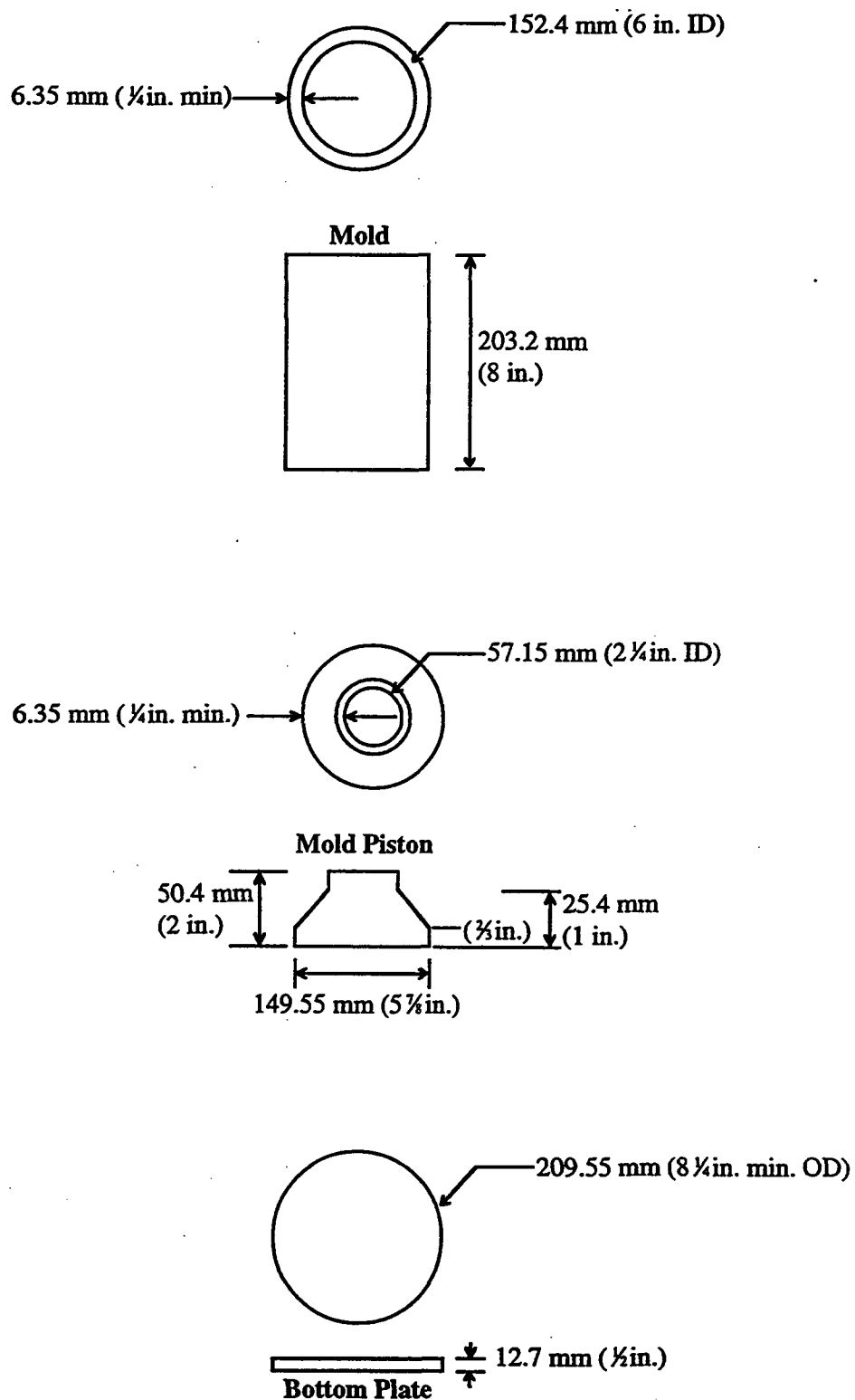


Figure 3: Mold Dimensions (All Dimensions ± 0.051 mm (0.002 in.))



MAX. DENSITY CURVE WORKSHEET

Lab. No. _____

Material Type: _____

Computed by: _____

Date: _____

SPECIFIC GRAVITY - COARSE

A. Wt Sample (g) _____

B. Wt Pycn + H₂O (g) _____

C. Wt Pycn w H₂O + A (g) _____

D. Wt Pycn w H₂O w Sample (g) _____

E. Displacement (ml) _____

$$\text{SpG Coarse} = \frac{A}{E} = \underline{\hspace{2cm}}$$

DENSITY - COARSE

F. Wt Sample (g) _____

G. Mold Volume (mm³) _____

H. Height Constant _____

I. Volume Correction _____

J. Corrected Volume:

$$G - (H \times I) \quad \underline{\hspace{2cm}}$$

$$\text{Density} = \frac{F}{J} \quad \underline{\hspace{2cm}}$$

LABOR CODES

T43J _____ T633 _____

SPECIFIC GRAVITY - FINE

K. Wt Sample (g) _____

L. Wt Pycn + H₂O (g) _____

M. Wt Pycn w H₂O + K (g) _____

N. Wt Pycn w H₂O + Sample (g) _____

O. Displacement (ml) _____

$$\text{SpG Coarse} = \frac{K}{O} = \underline{\hspace{2cm}}$$

DENSITY - FINE

P. Wt Sample (g) _____

Q. Mold Volume (mm³) _____

R. Height Constant _____

S. Volume Correction _____

T. Corrected Volume:

$$Q - (R \times S) \quad \underline{\hspace{2cm}}$$

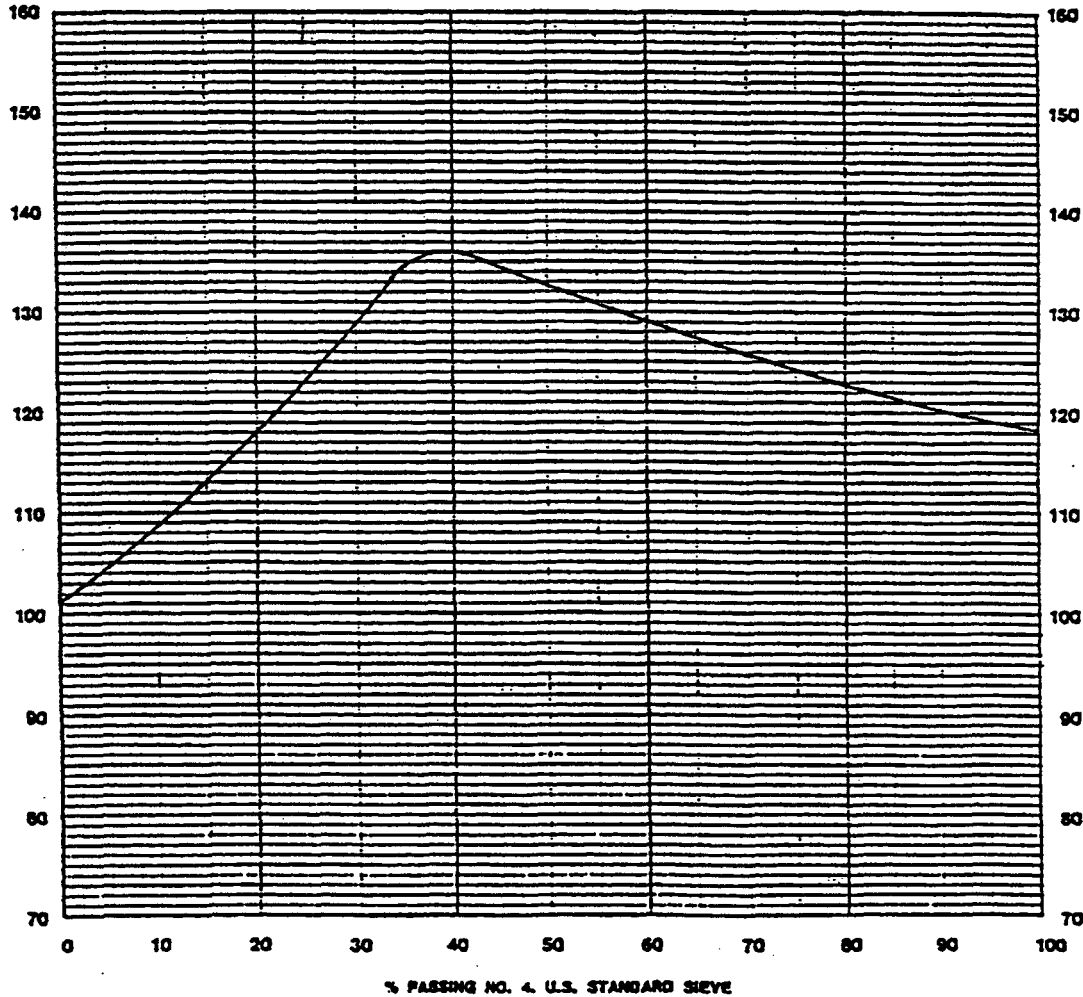
$$\text{Density} = \frac{P}{T} \quad \underline{\hspace{2cm}}$$

Figure 4: Maximum Density Work Sheet

MAXIMUM DENSITY CURVE

DEPARTMENT OF TRANSPORTATION
Materials Laboratory

LETTER NO. 72104
FIELD SAMPLE NO. 1
CONT. NO. 3191 F.A. NO. I-5-3(316) LAB NO. D-626
SECTION Puyallup River to King Co. Line SOURCE OF MATL. B-58
FIELD DESCRIPTION OF MATERIAL Crushed Surfacing
PERCENT PASSING #4 45 DATE RECEIVED June 2, 1987



DISTRIBUTION:

Mat'l Place X
Gen'l Place X
Dist. Admin. 3
Dist. Sols. Engr. W.R. Scott
Prov. Engr. B.J. Walker (2)
Const. Engr. X
Sols. Lab. X

DOT Form 361-008 (X)
Revised 3-84 -637

The approximate optimum moisture content is 7.8

The optimum moisture content of the No. 4 minus fraction, as determined by a standard proctor test, is 11.4

Specific Gravity Coarse 2.67

Specific Gravity Fine 2.69

J. R. STRADA, P.E.
Materials Engineer

By [Signature]

Date June 5, 1987

Figure 5-a: Maximum Density Curve Graph

DENS	REV. 03/17/82	Lab Ma
CONTROL	POINTS FOR DENSITY	CURVES
PASS 4	MAXIMUM	LOOSE
0.0	101.2	84.2
20.5	118.4	96.1
28.4	126.8	100.8
42.2	135.7	103.2
58.2	129.9	94.7
100.0	118.4	79.2

MAXIMUM DENSITY CURVE

% PASS #4	DRY WT LBS/CF	% PASS #4	DRY WT LBS/CF	% PASS #4	DRY WT LBS/CF	% PASS #4	DRY WT LBS/CF	% PASS #4	DRY WT LBS/CF
0	101.2	1	102.0	2	102.7	3	103.5	4	104.2
5	105.0	6	105.7	7	106.5	8	107.3	9	108.1
10	108.9	11	109.7	12	110.6	13	111.4	14	112.3
15	113.2	16	114.1	17	115.0	18	116.0	19	116.9
20	117.9	21	119.0	22	120.0	23	121.1	24	122.1
25	123.2	26	124.3	27	125.3	28	126.4	29	127.4
30	128.3	31	129.3	32	130.2	33	131.0	34	131.8
35	132.6	36	133.3	37	133.9	38	134.4	39	134.9
40	135.2	41	135.5	42	135.7	43	135.8	44	135.8
45	135.7	46	135.6	47	135.3	48	135.0	49	134.6
50	134.2	51	133.8	52	133.3	53	132.8	54	132.2
55	131.7	56	131.1	57	130.6	58	130.0	59	129.5
60	129.0	61	128.5	62	128.0	63	127.6	64	127.1
65	126.7	66	126.3	67	125.9	68	125.5	69	125.2
70	124.8	71	124.5	72	124.1	73	123.8	74	123.5
75	123.2	76	123.0	77	122.7	78	122.4	79	122.2
80	121.9	81	121.7	82	121.5	83	121.3	84	121.1
85	120.9	86	120.7	87	120.5	88	120.3	89	120.1
90	119.9	91	119.8	92	119.6	93	119.5	94	119.3
95	119.1	96	119.0	97	118.8	98	118.7	99	118.5
100	118.4								

LOOSE DENSITY CURVE

% PASS #4	DRY WT LBS/CF	% PASS #4	DRY WT LBS/CF	% PASS #4	DRY WT LBS/CF	% PASS #4	DRY WT LBS/CF	% PASS #4	DRY WT LBS/CF
0	84.2	1	84.8	2	85.3	3	85.9	4	86.4
5	87.0	6	87.6	7	88.1	8	88.7	9	89.2
10	89.8	11	90.4	12	91.0	13	91.5	14	92.1
15	92.7	16	93.3	17	93.9	18	94.5	19	95.1
20	95.7	21	96.4	22	97.0	23	97.6	24	98.2
25	98.8	26	99.4	27	100.0	28	100.5	29	101.0
30	101.5	31	101.9	32	102.3	33	102.6	34	102.9
35	103.2	36	103.3	37	103.5	38	103.5	39	103.6
40	103.5	41	103.4	42	103.2	43	103.0	44	102.7
45	102.3	46	101.9	47	101.5	48	101.0	49	100.4
50	99.9	51	99.3	52	98.7	53	98.0	54	97.4
55	96.8	56	96.1	57	95.5	58	94.8	59	94.2
60	93.6	61	93.1	62	92.5	63	92.0	64	91.4
65	90.9	66	90.4	67	89.9	68	89.5	69	89.0
70	88.6	71	88.1	72	87.7	73	87.3	74	86.9
75	86.5	76	86.1	77	85.8	78	85.4	79	85.1
80	84.7	81	84.4	82	84.1	83	83.8	84	83.5
85	83.2	86	82.9	87	82.6	88	82.3	89	82.0

Figure 5-b: Maximum Density Curve Chart

WSDOT Test Method No. 613

Method for Determining In-place Densities and Relative Compaction of Soils and Surfacing Materials Using the Troxler Nuclear Moisture/Density Gauge

1. SCOPE

- a. This test method provides a procedure for determining the in-place density and moisture content of compacted soils and surfacing materials using a nuclear moisture/density device in the direct transmission mode. Descriptions and procedures are referenced to the most common model of nuclear gauge in use: Troxler Model 3430. Other types of gauges utilize similar measuring procedures but may have controls designated and operated in a different manner. This method includes procedures for determining field moisture content and gradation negative to the 4.75 mm (U.S. No. 4) sieve.
- b. A density measurement is defined as being the average of two density readings taken at the same location at 90 degrees to each other. A valid density measurement will consist of two density readings agreeing within $\pm 50 \text{ kg/m}^3$ ($\pm 3 \text{ pcf}$) of each other.
- c. To determine if required compaction is being obtained in-place density tests must be taken at frequent intervals. Results of these tests are compared to density standards established for the material being compacted and are used as the basis for accepting or rejecting the work of the Contractor. Therefore, great care should be exercised to ensure accurate and consistent testing techniques.
- d. Each lift of material should be tested before subsequent lifts are placed. In selecting an area to be tested, sites should be chosen where the least compactive effort has been applied. If in-place densities do not meet specification requirements, additional compaction will be required and the area retested until such densities meet the minimum requirements.

2. EQUIPMENT

- a. Nuclear gauge kit comprised of:
 - (1) Nuclear moisture/density gauge.
 - (2) Standard block.
 - (3) Drill rod guide and leveling plate.
 - (4) Drill rod.
 - (5) Battery charger including 12-volt adapter.
 - (6) Log book.
 - (7) Envelope containing instruction manual emergency procedures and other gauge related paperwork.
 - (8) Carrying/transport case with foam inserts.
- b. Accessories necessary for performing test:
 - (1) Striking Hammer — 1.81 kg (4 lb.) maximum, for driving drill rod.
 - (2) 2.00 mm (U.S. No. 10) sieve for filling voids with fine native material
 - (3) Square point shovel for preparing test site.
 - (4) Sieves — 4.75 mm (U.S. No. 4) sieve with pan and cover. Additional larger size may be used to facilitate screening

- (5) With approximate capacity of 50 kg, accurate to 1 percent.
- (6) Sample Container — Capable of being sealed.
- (7) Dry Device — Infrared propane heater, hot plate, fry pan, or any other device that will dry the sample, without altering the material being heated. Alcohol drying may be used, where permitted by Region Safety Policy.
- (8) Utensils, such as spoons; sample drying pan; hot pad; or gloves; etc.

3. PROCEDURE

a. Preparation of Nuclear Density Gauge

- (1) It is recommended that the machine be turned on when leaving the office so the required warm-up time can take place during the travel to the job site. Always carry the machine in the carrying case designed for it.

The standard count for the day should be taken at the job site in order that the background levels of radiation and other variables will be the same as when testing.

- (2) Remove the Standard Block from the transport container and place it on a flat high-density surface, i.e., compacted soil, concrete or asphalt surface in an area at least 5 m (15 LF) from any vertical structure and 20 m (66 LF) or more from another nuclear gauge.
- (3) Remove the instrument and place it on the standard block with the calculator end of the gauge facing the metal plate on the standard block. The instrument must be firmly seated within the raised edges and pushed against the metal plate. Remove the lock from the trigger.
- (4) The position used for transport is the safe or shielded position and is also used to obtain the standard count i.e., MS (Moisture Standard) and DS (Density Standard).
- (5) The DENSITY STANDARD COUNT is to be recorded in the Log Book and the count must be within 1 percent of the average of the previous four Density Standard Counts recorded in the Log Book.

The MOISTURE STANDARD COUNT is to be recorded in the Log Book and the count must be within 2 percent of the average of the previous four Moisture Standard Counts recorded in the Log Book.

Since all calibration and measurements are made as ratios to the reference standard, these changes will not affect the calibration. A log will be kept on the gauges with a record of the standard counts. Any sudden change in either of the numbers may indicate a defect in the instrument.

b. Preparation of Density Test Location

- (1) In preparing the test site, the top 25 mm (1 in.) or 50 mm (2 in.) of material should be scraped away so that the moisture count accurately reflects the moisture content of the area. Do not alter materials, such as crushed surfacing top course, so as to result in a lift thickness of less than 50 mm (2 in.).
- (2) Using the scraper plate supplied with the instrument, carefully scrape the surface to smooth condition, removing all dried and loose material. If the scraping action dislodges surface stones, remove them, fill the voids with fine native material screened through the 2.00 mm (U.S. No. 10), and lightly tamp the surface.

- (3) Place the scraper plate in the middle of the site and drive the drill rod through the hole in the scraper plate into the soil using a hammer. Placing one foot on the plate will prevent it from slipping or otherwise damaging the site by allowing the drill rod to move from side to side. Safety glasses should be worn to protect the operators eyes in the event a breakage occurs either on the hammer face or the drill rod. The rod should be driven into the soil at least 50 mm (2 in.) further than the depth of measurement.

Note: The instrument is capable of taking measurements to a maximum depth of 203 mm (8 in.) in 50 mm (2 in.) increments.

- (4) In most cases, the rod can be withdrawn simply by pulling upward on the rod cap. If required, the scraper plate can be lifted up and used to lightly tap and pull the rod from the soil. Care should be used to prevent damage to the hole in the ground.
- (5) If a light mark is scribed around the scraper plate, it will be easier to position the gauge over the hole. The size of the plate and guide location matches the base of the gauge.

c. Nuclear Density Gauge Readings

- (1) Place the instrument over the site so that the source rod lines up with the hole. Depress the trigger and push the handle down to the properly indexed position at the desired depth. Be certain that the trigger is indexed into the slot in the index rod and not pushed below the slot. This is easily determined by pulling up and down on the handle without depressing the trigger. Pull the gauge towards the calculator end to seat the source rod against the side of the hole.
- (2) Start the test and, after a one minute time period, note the wet density.
- (3) Rotate the gauge at least 90 degrees and repeat the process of c(2). If the two readings agree within $\pm 50 \text{ kg/m}^3$ ($\pm 3 \text{ pcf}$), a valid density measurement has been obtained. If not retract the source rod and move to a new location.
- (4) Retract the source rod and remove the instrument from the test site.

d. Moisture and Gradation Analysis

- (1) Obtain a representative sample of the material directly beneath the gauge. A portion of the sample should represent each of the 90-degree readings. Place the sample in a sealed container for further analysis. If a maximum density curve has not been developed for the material being tested, obtain a sample large enough to accommodate either WSDOT Test Method 606 for FOP for AASHTO T 99 whichever is applicable.
- (2) Determine the moisture content per FOP for AASHTO T 255 and perform a grading analysis on the sample per the following to determine the amount passing or retained on the 4.75 mm (U.S. No. 4) sieve. In these expedient test methods, alcohol drying may be used in lieu of oven drying, where permitted by Region Safety policy. Under certain conditions where moisture content is of no concern or where it contributes an inconsequential percentage to the material passing the 4.75 mm (U.S. No. 4) sieve drying may be eliminated entirely.
- (3) Moisture Determination
 - (a) Conventional oven method.
 - 1) Weigh the sample in a tared container and record the mass (weight).

- 2) Dry the material to constant mass (weight) in the oven at $110^{\circ} + 6^{\circ}\text{C}$ ($230^{\circ} + 10^{\circ}\text{F}$) (approximately 24 hours).
 - 3) Record the dry mass (weight).
- (b) Expedient methods or drying source.
- Any suitable drying source listed may be used when the material is dried for other tests or the method is sufficiently accurate for the type of material being tested. Use of alcohol drying requires the use of special equipment and safety precautions to avoid personal injury.
- 1) Weigh the sample in a tared container and record the mass (weight).
 - 2) Dry to a constant mass (weight) stirring the sample to accelerate the removal of moisture. Constant mass (weight) is defined as, less than 1 g loss or less than 0.1 percent loss after an additional 30 minutes of drying.
 - 3) Record the dry mass (weight).
- (c) Calculations.
- 1) Calculate the percentage moisture using the following formula:

$$\text{Percent Moisture} = \frac{\text{wet mass (weight)} - \text{dry mass (weight)} \times 100}{\text{dry mass (weight)}}$$

(4) Gradation analysis.

This procedure is used as an expedient method to determine the distribution of particles relative to a 4.75 mm (U.S. No. 4) sieve. The sample used will be obtained from the density test location. Sample used for moisture content may be used for 4.75 mm (U.S. No. 4) sieve analysis.

- (a) Determine the initial mass of the sample to nearest 1 g.
- (b) Dry sample to a constant mass (weight) and record.
- (c) Nest the sieves specified in order of decreasing size of opening from top to bottom and place the sample on the top sieve.

Shake by hand for a sufficient period and in such manner that, after completion, not more than 0.5 percent by weight of the total sample passes any sieve during 1 minute shaking. Hold the assembled sieve(s) provided with a snug-fitting pan and cover, in a slightly inclined position in one hand. Strike the side of sieve sharply and with an upward motion against the heel of the other hand at the rate of about 150 times per minute, turn the sieve about one sixth of a revolution at intervals of about 25 strokes.

- (d) Remove and weigh the material on the 4.75 mm (U.S. No. 4) sieve and in the pan separately.

Note: The total weight of the material after sieving should check closely with original weight of sample placed on the sieves.

- (e) Divide the weights on the sieves by the initial dry weight, determine the amount of material passing the 4.75 mm (U.S. No. 4) sieve.

Note: Calculate the percentage passing to the nearest percent.

4. REPORTS AND CALCULATIONS

- a. Record all data on Field Density Test report, DOT Form 350-074 and Daily Compaction Test Report, DOT Form 351-015. (See Figures 4 and 5 for examples.)
- b. It should be stressed that the numbers obtained with the nuclear gauge are simply in-place densities and tell the operator nothing in regard to relative compaction. In-place densities are to be compared with theoretical maximum density curves as developed by WSDOT Test Method Nos. 606 and FOP for AASHTO T 99.
- c. Theoretical Maximum Density values require correction for oversize; that is, they must be corrected for the amount of material retained or passing the 4.75 mm (No. 4) sieve. Proceed with Paragraphs f. or g. as applicable.
- d. Oversize Correction for FOP for AASHTO T 99.
 - (1) This Test Method is applicable to nongranular, silty materials with less than 30 percent retained on the 4.75 mm (U.S. No. 4) sieve. AASHTO T 99 may be run in the field or by the Region Materials Lab.
 - (2) To correct for oversize, use a "flower pot" curve and proceed as follows:
 - (a) Obtain theoretical maximum dry density from AASHTO T 99 and plot this value on the left axis of the graph. This value should also be entered on DOT Form 350-074 on line: "Maximum Density kg/m³ (lbs./ft.³)"
 - (b) Obtain the specific gravity of the material retained on the 4.75 mm sieve and plot this value on the right axis of the graph. If this value is unknown, assume a value of 2.67.
 - (c) Draw a straight line between the two points plotted on the left and right axis of the graph.
 - (d) Enter the percent oversize (retained on 4.75 mm (U.S. No. 4) sieve) on the bottom or top axis of the graph and follow the vertical line until it intersects with the plotted diagonal line.
 - (e) From this point, draw a horizontal line to intersect the left axis. This value is the corrected maximum density and should be entered on WSDOT Form 350-74 on line: "Corrected Maximum Density from Flower Pot Curve kg/m³ (lbs./ft.³)."
 - (f) Percent Compaction is then calculated by the formula:

$$\text{Density kg/m}^3 (\% \text{ MAX}) = \frac{\text{Dry Density kg (lbs./ft.}^3\text{)}}{\text{Maximum Density kg (lbs./ft.}^3\text{)(MAX Corr.)}}$$

- e. Determination of Corrected Maximum Density for WSDOT Test Method No. 606.
 - (1) This test method is applicable to granular, free-draining materials and to materials with 30 percent or more retained on the 4.75 mm (U.S. No. 4) sieve. Test Method 606 requires specialized equipment and is run only by the Region or FOSSC Materials Lab.
 - (2) To determine corrected maximum density, enter the graph with the percent passing the 4.75 mm (U.S. No. 4) sieve on the bottom axis. Follow the vertical line from this point until it intersects with the maximum density curve. From this point, draw a horizontal line to the right or left axis and read the corrected maximum density. This value should be entered on DOT Form 350-074 on line: "Maximum Density" from appropriate curve kg/m³ (lbs./ft.³)."

- (3) An alternative way to determine corrected Maximum Density, refer to computer generated chart for percent passing the 4.75 mm (U.S. No. 4) sieve. This value should be entered on DOT Form 350-074 on line "Maximum Density" from appropriate curve kg/m^3 (lb./ft.^3).
- (4) Percent of compaction is then calculated by the formula:

$$\text{Density (\% MAX)} = \frac{\text{Dry Density kg/m}^3 (\text{lbs./ft.}^3) (100)}{\text{Maximum Density kg/m}^3 (\text{lbs./ft.}^3)}$$

5. PRECAUTIONS

- a. The Nuclear Gauge is a radioactive device. The radioactive source cannot be turned off. Always exercise personnel protection standards when in the vicinity of the gauge. When not in actual use, make sure the source rod is in the fully retracted or "safe" position.
- b. Only Licensed Operators are authorized to operate and handle the Nuclear Gauge. This is pursuant to WAC-246 and in agreement with the Department of Health, Radiation Control Unit and the U.S. Nuclear Regulatory Commission regulations Violation could cause suspension or revocation of Departmental Radioactive Materials Licenses.
- c. In case of an accident involving the Nuclear Gauge, follow the "Emergency Handling Procedures" packed with each gauge and contact the Radiation Safety Officer as soon as possible.
- d. The Nuclear Gauge is an expensive piece of equipment. Treat it with the respect it deserves NEVER leave the gauge unattended where it might be damaged by other equipment, traffic or the elements.

6. TROUBLESHOOTING

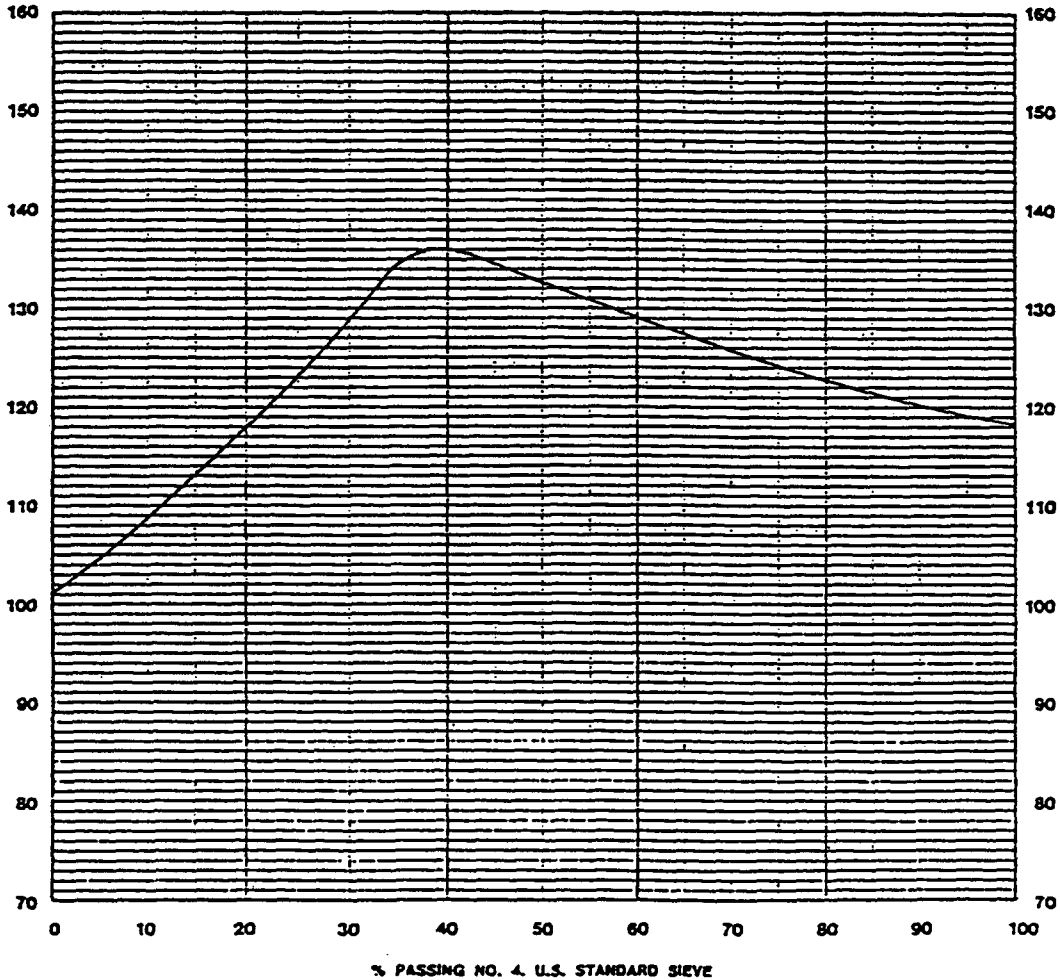
- a. If the Moisture or Density Standard Counts do not check within 2 percent and 1 percent respectively, do not immediately assume that the gauge is malfunctioning. Take another Standard Count. If the second count is within the prescribed parameters proceed as normal. If not, move the Standard Block to a new location making sure there are no outside influences such as other nuclear gauges, vertical surfaces, truck tires, trees or other materials containing hydrogen in the immediate vicinity (at least 20 m (66 LF)). Take another Standard Count. If the count is within the prescribed parameters proceed as normal. If not, take a second count. If the second count is still not within the prescribed parameters, it can be assumed the gauge is malfunctioning and should be removed from service.

8:P:DP/MM

MAXIMUM DENSITY CURVE

DEPARTMENT OF TRANSPORTATION
Materials Laboratory

LETTER NO. 72104
FIELD SAMPLE NO. 1 LAB NO. D-6261
CONT. NO. 3191 F.A. NO. I-S-3(316) S.R. NO. 5
SECTION Puyallup River to King C. Line SOURCE OF MATL. B-58
FIELD DESCRIPTION OF MATERIAL Crushed Surfacing
PERCENT PASSING #4 45 DATE RECEIVED June 2, 1987



DISTRIBUTION:
Mat'l File X
Gen'l File X
Dist. Admin. 3
Dist. Sales Engr. W.R. Scott
Proj. Engr. B.J. Walker (2)
Const. Engr. X
Spec. Lab. X

The approximate optimum moisture content is 7.8

The optimum moisture content of the No. 4 minus fraction, as determined by a standard proctor test, is 11.4

Specific Gravity Coarse 2.67
Specific Gravity Fine 2.69

J. R. STRADA, P.E.
Materials Engineer

By [Signature]
Date June 5, 1987

DOT Form 151-008 (X)
Revised 2-84 137

Figure 1-a

DENS	REV. 03/17/82	Lab Ma
CONTROL	POINTS FOR DENSITY	CURVES
PASS 4	MAXIMUM	LOOSE
0.0	101.2	84.2
20.5	118.4	96.1
28.4	126.8	100.8
42.2	135.7	103.2
58.2	129.9	94.7
100.0	118.4	79.2

MAXIMUM DENSITY CURVE

% PASS #4	DRY WT LBS/CF	% PASS #4	DRY WT LBS/CF	% PASS #4	DRY WT LBS/CF	% PASS #4	DRY WT LBS/CF	% PASS #4	DRY WT LBS/CF
0	101.2	1	102.0	2	102.7	3	103.5	4	104.2
5	105.0	6	105.7	7	106.5	8	107.3	9	108.1
10	108.9	11	109.7	12	110.6	13	111.4	14	112.3
15	113.2	16	114.1	17	115.0	18	116.0	19	116.9
20	117.9	21	119.0	22	120.0	23	121.1	24	122.1
25	123.2	26	124.3	27	125.3	28	126.4	29	127.4
30	128.3	31	129.3	32	130.2	33	131.0	34	131.8
35	132.6	36	133.3	37	133.9	38	134.4	39	134.9
40	135.2	41	135.5	42	135.7	43	135.8	44	135.8
45	135.7	46	135.6	47	135.3	48	135.0	49	134.6
50	134.2	51	133.8	52	133.3	53	132.8	54	132.2
55	131.7	56	131.1	57	130.6	58	130.0	59	129.5
60	129.0	61	128.5	62	128.0	63	127.6	64	127.1
65	126.7	66	126.3	67	125.9	68	125.5	69	125.2
70	124.8	71	124.5	72	124.1	73	123.8	74	123.5
75	123.2	76	123.0	77	122.7	78	122.4	79	122.2
80	121.9	81	121.7	82	121.5	83	121.3	84	121.1
85	120.9	86	120.7	87	120.5	88	120.3	89	120.1
90	119.9	91	119.8	92	119.6	93	119.5	94	119.3
95	119.1	96	119.0	97	118.8	98	118.7	99	118.5
100	118.4								

LOOSE DENSITY CURVE

% PASS #4	DRY WT LBS/CF	% PASS #4	DRY WT LBS/CF	% PASS #4	DRY WT LBS/CF	% PASS #4	DRY WT LBS/CF	% PASS #4	DRY WT LBS/CF
0	84.2	1	84.8	2	85.3	3	85.9	4	86.4
5	87.0	6	87.6	7	88.1	8	88.7	9	89.2
10	89.8	11	90.4	12	91.0	13	91.5	14	92.1
15	92.7	16	93.3	17	93.9	18	94.5	19	95.1
20	95.7	21	96.4	22	97.0	23	97.6	24	98.2
25	98.8	26	99.4	27	100.0	28	100.5	29	101.0
30	101.5	31	101.9	32	102.3	33	102.6	34	102.9
35	103.2	36	103.3	37	103.5	38	103.5	39	103.6
40	103.5	41	103.4	42	103.2	43	103.0	44	102.7
45	102.3	46	101.9	47	101.5	48	101.0	49	100.4
50	99.9	51	99.3	52	98.7	53	98.0	54	97.4
55	96.8	56	96.1	57	95.5	58	94.8	59	94.2
60	93.6	61	93.1	62	92.5	63	92.0	64	91.4
65	90.9	66	90.4	67	89.9	68	89.5	69	89.0
70	88.6	71	88.1	72	87.7	73	87.3	74	86.9
75	86.5	76	86.1	77	85.8	78	85.4	79	85.1
80	84.7	81	84.4	82	84.1	83	83.8	84	83.5
85	83.2	86	82.9	87	82.6	88	82.3	89	82.0

Figure 1-b



Washington State
Department of Transportation

SOIL SAMPLE TESTS

JOB NO. <i>Cont. 2702</i>	SH R. <i>SR-82</i>	SAMPLE NO.
SECTION <i>M.P. 84.01 to KIONA</i>		LAB. NO.
FIELD DESCRIPTION		BIN NO.
		DATE RECD.

GRAING ANALYSIS				Operator		CONSTANTS		
WT. PASSED RETAINED	FRACTIONS		PASSING	AS USED		Can No.	LIQUID LIMIT	PLASTIC LIMIT
	WT.	%	SIEVE	%	SIZE			
-1/8"			1/8"					
1/8"-1"			1"		3/8"			
1"-2"			2"					
2"-4"			4"		3/8"-No. 4			
4"-No. 4			No. 4				No Blows	
Pass No. 4			10		Pass No. 4		L.L.	
Total			40				P.L.	
Est. Fract.			200				P.I.	
Date (Coarse)				Specific Gravity		HRB Class, Group Index		Ph
Date (Fine)				Textural Class				

Operator				STABILOMETER TEST				Data				MOISTURE-DENSITY (AASHTO T-99-57)			
cc. Temp. H ₂ O				A	B	C	D	H ₂ O Water Cont.				Date			
Cc. H ₂ O added								Can No.	94	95	96	97	98	99	
% H ₂ O added								Est. % H ₂ O	12.0	14.0	16.0	18.0	20.0	22.0	
Initial % H ₂ O								Spec. wt.	1573	1635	1700	1755	1773	1765	
Molding % H ₂ O								Wet wt.	59.89	66.87	68.93	70.46	75.33	83.62	
Molding Density								Dry wt.	51.76	56.87	57.65	57.95	61.22	66.54	
Compactor pressure								Wt. H ₂ O	8.13	10.00	11.28	12.51	14.11	17.08	
No. blows								% H ₂ O	15.8	17.6	19.6	21.6	23.0	25.7	
Wt. in mold								Dry density	89.4	91.4	93.5	94.9	94.8	92.3	
Wt. in mold (soaked)															
Wt. of mold ----->															
Net wt. of soil															
Height															
Exudation pressure															
Swell pressure															
Drainage															
Stabil. "Ph" - 500 No.															
- 1000 No.															
- 2000 No.															
Displacement "D"															
"R" value															
Gravel equivalent															
Swell equivalent															

RECD SURF. DEPTH: BY "R" _____ By Swell _____

TRAFFIC INDEX _____

RECD SURF. DEPTH: By "R" _____

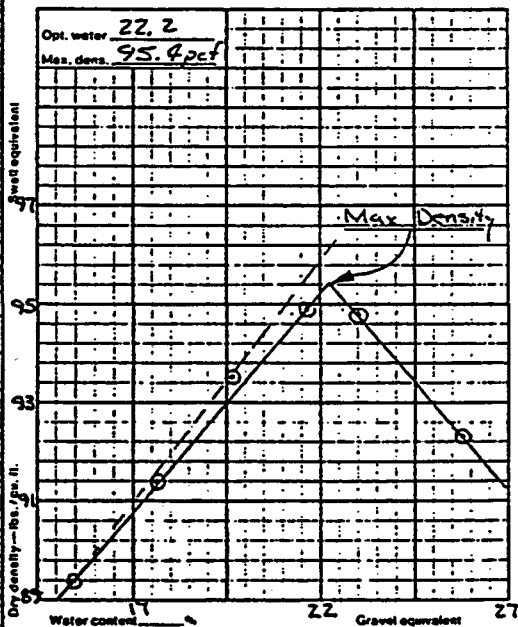
Swell Pressure _____ psi

Surfacing Depth _____ ft.

Remarks:

LAB NO. *27102*

BIN NO. _____



DOT FORM 351 007
REVISED 5-85 1075

WHITE COPY—Grading & Constants YELLOW COPY—Stabilometer

Figure 2

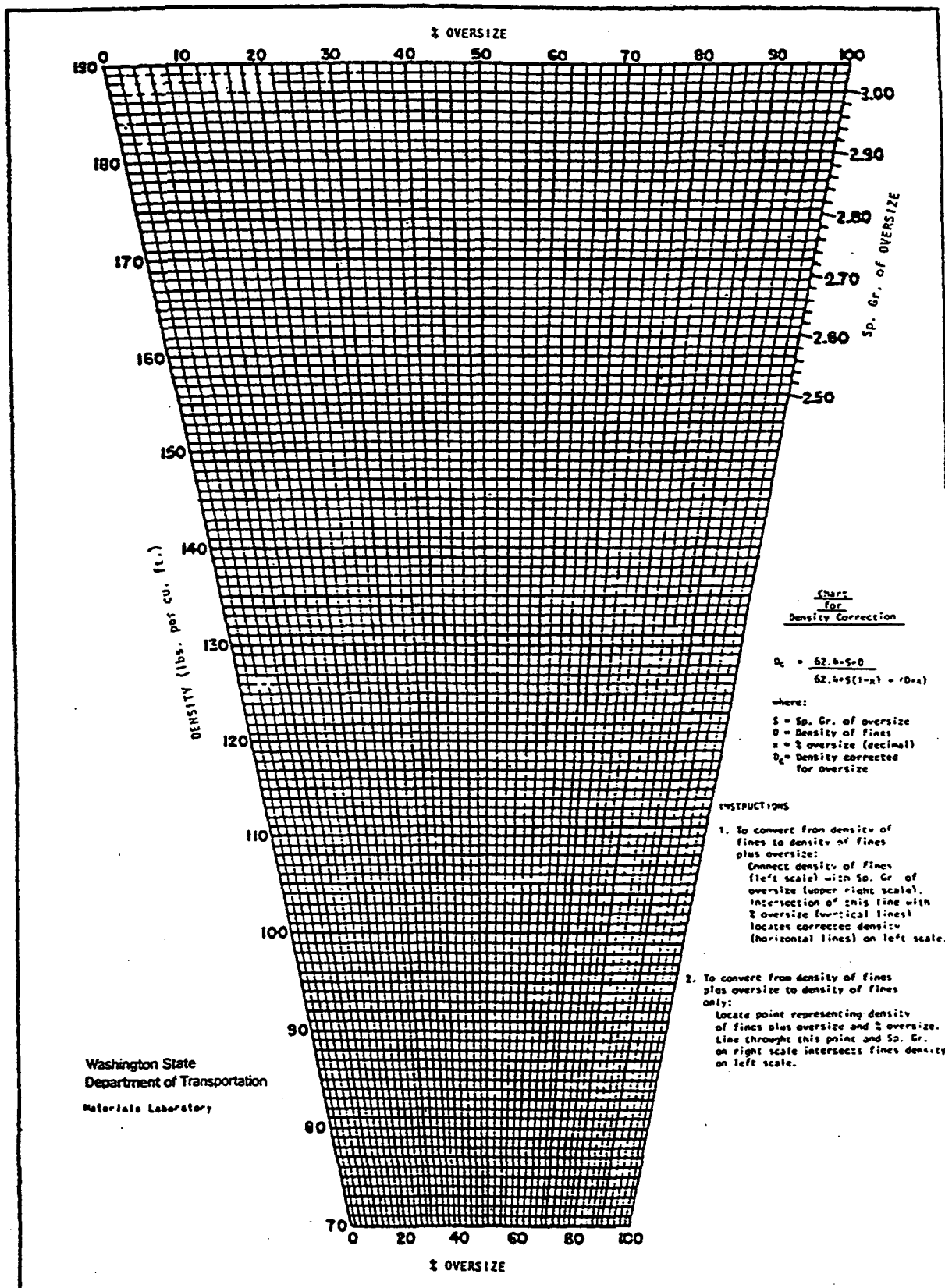


Figure 3

FIELD DENSITY TEST REPORT
NUCLEAR MOISTURE-DENSITY GAUGE METHOD

DEPARTMENT OF TRANSPORTATION
WORK SHEET

Contract No. 2845 SR No. 500 Section SR 503 to Ward Road
Inspector L. Peter Date 1-15-87

TEST HOLE NO.	14	15	TC 2	TC 2A
Station to Station	14+60	24+80	3+95	3+95
Test Station	12' 11"	7' 8"	4' 8"	4' 8"
Reference to Center Line	-3.6	-1.0	+8.0	+8.0
Reference to Subgrade	As sub. st. B.S. silt		C.S.T.C	C.S.T.C
Material (Silt, Clay, Top Course, etc.)			0.20	0.20
Depth of Material (If surfacing)				

DENSITY "DETERMINATION"

Wet Density lbs/cu ft	0	124.4	127.6	138.4	146.6
Wet Density lbs/cu ft (test)	90	125.2	124.4	138.0	149.8
Wet Density lbs/cu ft (test)	Avg.	124.8	126.3	138.2	145.7
Dry Density lbs/cu ft	0	—	—	—	—
Dry Density lbs/cu ft (test)	90	—	—	—	—
Dry Density lbs/cu ft (test)	Avg.	106.1	109.4	132.8	135.9
Moisture lbs/cu ft	0	—	—	—	—
Moisture lbs/cu ft (test)	90	—	—	—	—
Moisture lbs/cu ft (test)	Avg.	—	—	—	—
Moisture %	0	18.2	16.9	4.7	7.9
Moisture % (test)	90	17.3	17.3	4.1	8.3
Moisture % (test)	Avg.	17.8	17.1	4.4	8.1
Moisture (Correction K)		—	—	—	—
Dry Density lbs/cu ft (Max.)		110.2	110.2	141.8	141.0
Dry Density lbs/cu ft (Max. Corr)		—	116.0	—	—
Dry Density lbs/cu ft (% of Max)		96.3	94.3	93.7	96.0
Standard No.		4934	4934	4660	4660

MOISTURE DETERMINATION

Wt. Damp Soil + Tare	9.81	10.35	12.16	12.56
Wt. Dry Soil + Tare	8.65	9.17	11.76	11.84
Wt. of Moisture	1.16	1.18	.40	.74
Wt. of Tare	2.05	1.98	2.05	2.05
Wt. Dry Soil	6.60	7.19	9.71	9.79
Moisture % (test)	17.6	16.4	4.1	7.6
Moisture % (optimum)	17.2	17.2	7	7
Moisture % (corrected)	—	14.6	—	—

GRADATION DETERMINATION (Use Dry Sample from Moisture Determination)

Wt. Retained on No. 4 Sieve + Tare	3.06	7.16	7.71
Wt. of Tare	1.98	2.05	2.05
Wt. of Material Retained on No. 4 Sieve	1.08	5.11	5.66
Wt. of Dry Soil	7.19	9.71	9.77
% Retained No. 4 Sieve (% Oversize)	15	53	58
% Passing No. 4 Sieve (100 - % Retained)	100	85	47

NOTE: If retest, add letter to number such as 1st test No. 27, retest 27A

Information to be transferred to DOT 351-015 - DAILY COMPACTION TEST REPORT

$$\% \text{ Moisture} = \frac{\text{Wt. of Moisture} \times 100}{\text{Wt. of Dry Soil}}$$

$$\text{Wet Density} = \frac{\text{Wt. of Wet Soil}}{\text{Vol. of Hole}}$$

$$1 \text{ gram} = 0.0022 \text{ lbs}$$

$$1 \text{ lb} = 453.6 \text{ grams}$$

$$\text{Dry Density} = \frac{\text{Wet Density}}{1 + \frac{\% \text{ Moisture}}{100}}$$

$$\% \text{ Retained No. 4 Sieve} = \frac{\text{Wt. Retnd. No. 4 Sieve}}{\text{Wt. of Dry Soil}} \times 100$$

$$\% \text{ Max. Density} = \frac{\text{Dry Density} \times 100}{\text{Max Density}}$$

$$\text{Moist Corr. K} = \frac{\% \text{ M (true)} - \% \text{ M (gaugel)}}{\% \text{ M (gaugel)} - 100} \times 1000$$

DOT FORM 350-074
5/81

Figure 4

DEPARTMENT OF HIGHWAYS

Cont. No. 2845

Date 1-15-87

Page No. 1 of 1

Optimum Moisture	-	Moisture content of No. 4 minus from Proctor curve.
Corrected Moisture	-	Optimum moisture corrected for oversize = Optimum Moisture Content X Percent Passing No. 4 Sieve.
Maximum Dry Density	-	Density from Proctor curve or Maximum Density for Granular Materials Curve.
Corrected Density	-	Proctor Maximum Dry Density corrected for oversize.
Standard Number	-	Laboratory or identifying number of Density Standard used, i.e., Proctor No. or Maximum Density Curve No.
Field Test	-	Moisture content or Density of field sample tested.

Method of Compaction (Specified): A, B, C, Rock Embankment (RO), Bridge Approach Embankment (BA)

• Note corrective action under remarks:

SUMMARY OF COMPACTION QUANTITIES

DISTRIBUTION: 11dg. Const. Eng.
 District Const. Eng.
 Project Eng.
 Dist. Solls Eng.
 HWY FORM 351-015 (MF 11-73)
 REVISED 3/73

REMARKS: Test #15 Above 94% contractor rolled 2 additional passes
TC-2 contractor water CTC and rolled 2 passes, retest
passed.

INSPECTOR

WSDOT Test Method No. 715

Method of Test for Relative Compaction of Asphalt Concrete Pavement

1. GENERAL SCOPE

- a. This test method provides a procedure for determining the in-place density of compacted asphalt concrete pavements. Asphalt concrete density measurements are made using a "thin lift" nuclear moisture-density gauge in the backscatter mode of transmission, or with a gauge in the direct transmission mode if the material has adequate depth.
- b. A density measurement shall be the average of two density readings taken in the same location at 90 degrees from each other. The readings shall agree within $\pm 50 \text{ kg/m}^3$ ($\pm 3 \text{ lbs./ft.}^3$) to be valid.
- c. On the basis of specified acceptance criteria, the compaction values are used to determine compliance or noncompliance of compaction specifications within a designated area.

2. EQUIPMENT

- a. Nuclear gauge and standardizing block (reference standard).
- b. Guide plate, drill rod, and hammer.
- c. Cans of spray paint or crayons for marking test sites.
- d. Required report forms.

3. GAUGE CALIBRATION

- a. It is recommended that the machine be turned on when leaving the office so the required warm-up time can take place during the travel to the job site. Always carry the machine secured in the carrying case designed for it. The standard count for the day should be taken at the job site in order that the background levels of radiation and other variables will be the same as when testing.

Note: Descriptions and procedures are referenced to the most common model of nuclear gauge in use: Troxler Model 3430. Other types of gauges utilize similar measuring procedures but may have controls designated and operated in a different manner.

- b. Remove the standard block from the transport container and place it on a flat high-density surface, i.e., compacted soil, concrete or asphalt surface in an area at least 5 m (15 LF) from any vertical structure and 20 m (66 LF) or more from another nuclear gauge.
- c. Remove the instrument and place it on the standard block with the calculator end of the gauge facing the metal plate on the standard block. The instrument must be firmly seated within the raised edges and pushed against the metal plate. Remove the lock from the trigger and check the POWER switch to be sure it is in the ON position.
- d. The position used for transport is the safe or shielded position and is also used to obtain the standard counts, i.e., MS (Moisture Standard) and DS (Density Standard).
- e. The DENSITY STANDARD COUNT which is to be recorded in the Log Book, must be within 1 percent of the average of the previous four DENSITY STANDARD COUNTS recorded in the Log Book.

The MOISTURE STANDARD COUNT which is to be recorded in the Log Book, must be within 2 percent of the average of the previous four MOISTURE STANDARD COUNTS recorded in the Log Book.

Since all calibration and measurements are made as ratios to the reference standard, these changes will not affect the calibration. A log will be kept on the gauges with a record of the standard counts. Any sudden change in either of the numbers may indicate a defect in the instrument.

- f. Locate the test site as described in WSDOT Test Method No. 716.

4. PROCEDURE FOR DIRECT TRANSMISSION MODE

- a. Prepare the test site as follows:

- (1) Place the scraper plate in the middle of the test site, place one foot on the plate to hold it in position, and drive the drill rod into the mat using a 1.3 to 1.8 kg (3 to 4 lb.) hammer. The rod is to be driven into the mat at least 6.35 mm ($\frac{1}{4}$ in.) further than the testing depth. The testing depth is in increments of 50 mm (2 in.), therefore, the minimum depth of the drill hole is 57 mm ($2\frac{1}{4}$ in.). Use safety glasses while driving the drill rod.
- (2) In most cases the drill rod can be withdrawn simply by pulling upward on the rod cap. If difficulty is encountered, the scraper can be used to lightly tap and pull the rod from the mat. Care should be used to prevent enlarging the hole.

- b. Set up gauge on test site as follows:

- (1) Place the instrument over the prepared test site so that the source rod lines up with the hole. Depress the trigger and push the handle down to the properly indexed position at the desired test depth. Be certain that the trigger is indexed into the slot in the index rod. Pull the gauge toward the calculator end so as to seat the source rod against the side of the hole.
- (2) Start the test and note the wet density after a one minute time period.
- (3) The number shown is the wet density in kg/m^3 (lb./ft.^3). If correlation cores are to be taken, outline the position of the gauge with spray paint and mark the test number with spray paint.
- (4) Rotate the gauge 90 degrees and repeat the process steps b.(2) and b.(3). Check the validity of the results, the two readings are to be within $\pm 50 \text{ kg/m}^3$ ($\pm 3 \text{ lb./ft.}^3$) in order to be considered to be acceptable.
- (5) Retract the source rod and remove the gauge from the test site.

5. NUMBER AND LOCATIONS OF NUCLEAR TESTS

- a. The area concept in the testing of control lots will be used with this test.
- b. Control lots.

Control lots representing 400 metric tonnes (400 tons) or less of mix shall be established. Nuclear gauge tests for compaction control during paving construction shall be taken at a minimum of five locations per control lot. The locations will be picked at random by the Engineer using WSDOT Test Method No. 716.

6. ACCEPTANCE

- a. For acceptable compaction, nuclear gauge test results for the control shall be as required by current specifications or contract plans.
- b. Whenever the density so determined is greater than 98 percent of Rice density for wearing course, a change in mix design will be required.

WSDOT Test Method No. 718

Method of Test for Determining Stripping of Asphalt Concrete

1. SCOPE

- (A) This test is used to determine the amount of stripping resulting from the action of water on laboratory-compacted asphalt concrete mixtures. Specimens shall be compacted as per WSDOT Test Method No. 702.
- (B) This test is technically equivalent to AASHTO T-283.

2. EQUIPMENT

- (A) Water bath controlled at $60^{\circ} \pm 0.5^{\circ}\text{C}$.
- (B) Dessicator capable of holding a vacuum (26 mm Hg) and large enough to accommodate test specimens and volume of water as described in the procedure.
- (C) Perforated platform to hold test specimens off the bottom of the dessicator to assure complete saturation.
- (D) Vacuum pump, vacuum system or water aspirator, for vacuum-saturation of specimens.
- (E) A conventional air-bath freezer.
- (F) Transfer dish — (approximate dimensions) 120 mm diameter by 66 mm high Pyrex dish.
- (G) Water bath controlled at $13^{\circ} \pm 0.5^{\circ}\text{C}$.
- (H) Compression machine meeting requirements of AASHTO T-246 and capable of producing a uniform vertical movement of 1.65 mm per minute.

3. PROCEDURE

- (A) Fill dessicator with distilled water, at room temperature, to a level at least 25.4 mm above and 50.8 mm below specimen level.
- (B) Place specimens in dessicator for vacuum saturation.
- (C) Apply a minimum vacuum of 26 mm Hg to the dessicator for 30 minutes, during which time the dessicator should be agitated at 5 minute intervals.
- (D) After 30 minutes of vacuum, remove specimen and place in plastic bag. Fold top of plastic bag over in such a way that the specimen is effectively sealed.
- (E) Place specimen in a conventional air-bath freezer for 15 hours at temperature $-18^{\circ} \pm 3^{\circ}\text{C}$.
- (F) After freezing for approximately 15 hours, remove specimen from freezer, remove from bag and place in a transfer dish. Place transfer dish containing the specimen in a $60^{\circ} \pm 0.5^{\circ}\text{C}$ water bath for 24 hours.
- (G) After conditioning in hot water bath for 24 hours, remove from transfer dish and place in $13^{\circ} \pm 0.5^{\circ}\text{C}$ water bath for 2 hours.
- (H) After conditioning in cold water bath for 2 hours, remove from bath, quickly surface dry by towel blotting and place specimen into the compression machine on the diametrical vertical plane. Apply the diametrical loading at a vertical deformation rate of 1.65 mm per minute. Record the maximum compressive load. Continue to load until specimen can be broken open easily.

- (I) Remove the sample from compression machine, break the specimen in half, by hand, for later visual inspection.
- (J) Record % of retained strength by dividing the maximum compressive load of each sample by the maximum compressive load obtained on an unconditioned sample containing no anti-stripping additive.
- (K) Record visual condition of each specimen as to stripping action: none, slight, moderate, or severe.

NONE: The sample condition is solid with no evidence of asphalt cement withdrawing from the aggregate. After the sample has air-dried, the appearance is black.

SLIGHT: The sample condition is solid to slightly soft with evidence of the asphalt cement beginning to withdraw from the edges and surfaces of the aggregates. After the sample has air-dried, the appearance remains black.

MODERATE: The sample condition is soft, easily broken in half, with partial to completely exposed aggregates. After the sample has air-dried, the appearance will be slightly gray.

SEVERE: The sample condition is soft to falling apart with the majority of coarse aggregate completely exposed and asphalt cement almost nonexistent. After the sample has air-dried, the appearance is gray.

12:DP/MM

WSDOT Test Method No. 722

Method of Test for Determination of Asphalt Content by Nuclear Method

1. SCOPE

- a. This method covers a procedure for the determination of asphalt content of an asphalt concrete mixture using the Troxler Model 3241C Nuclear Asphalt Content Gauge. This test method generally utilizes information obtained from cross calibration and from a job mix calibration by another gauge. These procedures are included as Appendix 2 and Appendix 1.

2. APPARATUS

- a. Troxler Model No. 3241C Nuclear Asphalt Content Gauge.
- b. Metal sample pans supplied with the gauge.
- c. Metal plate, plywood, or other rigid flat object which can be used to flatten the sample level with the top of the sample pan.
- d. Balance (capacity of 11 kg and sensitive to 0.1 g).
- e. Thermometer (capable of measuring to 176°C (350°F)).
- f. Miscellaneous Hand Tools — Spatula, scoop, spoon, putty knife.

3. STANDARDIZATION

- a. The asphalt content gauge is sensitive to its surroundings. Be sure to locate the gauge in a place in the test lab where it will not need to be moved and where it will be away from water sources such as storage tanks, wet scrubbers, wash racks, etc., and other nuclear devices. Keep the top of the chamber free of all materials.
- b. Turn the console on and allow at least 15 minutes warm-up time after gauge indicates "ready."
- c. Set printer to "on" (press **SHIFT**, **AUTO**).
- d. Set the time to "16 minutes" (press **TIME**).
- e. Take a 16-minute background count with nothing in the chamber. Press **BKG** and follow the directions on the console for running a background count. Be sure to use the new background count for your testing. Record the background count in the book provided with the nuclear asphalt content gauge. A background count should be taken prior to the first test run each day. If the results vary by more than 1 percent from the previous recording, a new background count should be taken and background counts should be taken more frequently.

If conditions around the gauge change during the day, additional background counts should be taken and recorded.
- f. The cross calibration(s) and the job mix calibration need to be stored in the gauge. A step by step data input procedure is attached. The readout on the console also leads the operator through this procedure.

Note: Cross calibration may already be in the gauge.

Note that the *field* gauge is the gauge that is being used for the testing, and the *master* gauge is the gauge that was used for the nuclear asphalt content calibration.

Note the *master gauge transfer number*. It is critical this number series and concept be maintained when using the cross-calibration concept. The order is the last three digits of the master gauge serial number, a dot (.), then the last three digits of the field gauge serial number. Example: 106.302.

- g. Assurance or independent assurance samples of asphalt concrete sent to the region or the FOSSC Materials Lab need to be identified by the calibration number. This ensures that all can recognize which mix design and calibration is being used for acceptance.

4. PROCEDURE

- a. Select the proper calibration number that has been stored in the gauge.
- b. Set the test time to 8 minutes.
- c. Obtain a sample of asphalt concrete mix using WSDOT Test Method 712. Generally, three (3) test specimens will be obtained using this procedure outlined. One sample is for the nuclear asphalt content gauge, approximately 8000 g. The second sample is for a moisture content and is taken and tested at the same time as the nuclear asphalt content, approximately 500 g. The third sample is the quick wash for aggregate gradation, approximately 1000 g.
- d. Heat the sample pan to the $135^{\circ} \pm 14^{\circ}\text{C}$ ($275^{\circ} \pm 25^{\circ}\text{F}$) or to the mix temperature prior to filling.
- e. Fill the nuclear gauge sample pan with hot mix to approximately one-half the height of the pan and level it out with a suitable tool such as a putty knife. Do not compact this material. Continue adding material to the sample pan until the weight of the mix in the pan is within ± 5 g of the blank mass (weight) as established during the nuclear asphalt content calibration for this job.
- f. Immediately after filling the sample pan, place the metal, plywood, or other rigid flat object on the mix and sample pan and compact the sample into the pan by standing or kneeling on the flat object until it is level with the rim of the pan.
- g. Recheck the mass (weight) of the mix in the pan to ensure that it is within ± 5 g of the blank mass (weight).
- h. Place the sample pan containing the asphalt mix in the asphalt content gauge. Press **START** and follow the direction on the console for the nuclear asphalt content gauge to determine the percent of asphalt cement. Reverse the sample pan and determine a second reading. Average the two readings and record the information. When quick washes are to be done, this information should be recorded on DOT Form 350-100A (Quick Wash with Nuclear Asphalt). If the difference between the two readings is greater than 0.4 percent, refill the pan and start again.
- i. The moisture content of this material, run in accordance with WSDOT Test Method 713, needs to be determined at the same time and from a split of the same material used for nuclear asphalt content. Record the moisture content in the appropriate areas. If using the quick wash procedure with nuclear asphalt, record the information on DOT Form 350-100A.

Note: If the filled nuclear asphalt content pan has been allowed to cool to room temperature, it shall be reheated to $135^{\circ} \pm 14^{\circ}\text{C}$ ($275^{\circ} \pm 25^{\circ}\text{F}$) or to the mix design temperature prior to testing. A new moisture content sample shall be taken from the sample pan immediately after the asphalt percent determination has been made.

5. CALCULATIONS

- a. The asphalt content obtained from the nuclear asphalt content gauge is corrected for moisture by subtracting moisture percent obtained from the moisture content obtained in WSDOT Test Method 713. Record the percent corrected asphalt on the Quick Wash with Nuclear Asphalt form (DOT Form 350-100A), if the quick wash procedure is being used.

CROSS-CALIBRATION DATA INPUT PROCEDURE (IF REQUIRED)

1. [SHIFT] [SPECIAL], [YES], [5] - Calib. Trans.
2. [1] - Cross Calib.
3. How many samples (5-12)? Input 6 and Press [ENTER]
4. Field Gauge Measurement, [1] - Keypad input
5. Field Gauge Background: _____ [ENTER]
6. Field Gauge Sample #1 count: _____ [ENTER]
7. Field Gauge Sample #2 count: _____ [ENTER]
8. Field Gauge Sample #3 count: _____ [ENTER]
9. Field Gauge Sample #4 count: _____ [ENTER]
10. Field Gauge Sample #5 count: _____ [ENTER]
11. Field Gauge Sample #6 count: _____ [ENTER]
12. Master Gauge Background: _____ [ENTER]
13. Field Gauge Sample #1 count: _____ [ENTER]
14. Field Gauge Sample #2 count: _____ [ENTER]
15. Field Gauge Sample #3 count: _____ [ENTER]
16. Field Gauge Sample #4 count: _____ [ENTER]
17. Field Gauge Sample #5 count: _____ [ENTER]
18. Field Gauge Sample #6 count: _____ [ENTER]
19. Review Data:
[1] - Printout
20. Master Gauge Transfer Number: _____
Note: A B C
A = last 3 digits of master gauge serial number (.)
B = last 3 digits of the field gauge serial number
C = blank
21. Cross Calib. completed and stored! Press [ENTER]

CALIBRATION TRANSFER DATA INPUT PROCEDURE

1. [SHIFT] [SPECIAL], [YES], [5] - Calib. Trans.
2. [2] - Transfer
3. [2] - Next Trans # (scroll to required transfer number)
4. [1] - Select
5. A1: _____
Select: 1 = +
 2 = -
6. Input A1 and press [ENTER]
7. A2: _____
Select: 1 = +
 2 = -
8. Input A2 and press [ENTER]
9. A3: _____
Select: 1 = +
 2 = -
10. Input A3 and press [ENTER]
11. Input the design calibration Background Count _____ [ENTER]
12. Input the Blank Mass (weight) _____ g. [ENTER]
13. Calibration Activated! Want to store Calibration? [YES]
14. Input the Calibration # _____ from the design and press [ENTER]
15. Input the Mix ID # _____ from the design and press [ENTER]

15:P:DP/MM

WSDOT Test Method No. 722, Appendix 1

Method of Test for Calibration of the Troxler 3241C Nuclear Asphalt Content Gauge for Job Mix

1. SCOPE

- a. This method covers a procedure for a four-pan calibration of the Troxler 3241C Asphalt Content Gauge for a particular job aggregate and asphalt.

2. APPARATUS

- a. Troxler Model No. 3241C Nuclear Asphalt Content Gauge.
- b. Four metal sample pans for the nuclear asphalt content gauge.
- c. Metal plate, plywood, or other rigid flat object which can be used to flatten the sample level with the top of the sample pan.
- d. Balance (capable of 16 kg (35.28 lbs.) and sensitive to 0.1 g).
- e. Thermometer (capable of measuring to 176°C (350°F)).
- f. Miscellaneous Hand Tools — Spatula, scoop, spoon, putty knife, straightedge.
- g. Mixer — Mixing can be by hand but a mixer similar to the Hobart A200 is preferred.
- h. Bowls and mixing paddle compatible with the mixer that will adequately mix approximately 8000 g of asphalt concrete. Bowls and spoons if mixed by hand.

Note: The mixing bowl and paddle needs to be heated to the mixing temperature and buttered with asphalt and aggregate prior to mixing.

- i. Oven(s) for heating the bowls and material to 135°C (275°F).

3. STANDARDIZATION

- a. The asphalt content gauge is sensitive to its surroundings. Be sure to locate the gauge in a place in the test lab where it will not need to be moved and where it will be away from water storage tanks and at least 9 m (30 LF) from other nuclear devices. Keep the top of the chamber free of all materials.
- b. Turn the console on and allow at least 15 minutes warm-up time after gauge indicates "ready."
- c. Set printer to "on" (press **SHIFT, AUTO**).
- d. Set the time to "16 minutes" (press **TIME**).
- e. Take a 16-minute background count with nothing in the chamber. Press **BKG** and follow the directions on the console for running a background count. Record the background count in the book provided with the nuclear asphalt content gauge. If the results vary by more than 1 percent from the previous recording, a new background count should be taken and background counts should be taken more frequently.

If conditions around the gauge change during the calibration, the testing should be stopped, and a new background count taken and the testing started over.

4. PROCEDURE

- a. Obtain samples of asphalt and aggregate to be incorporated into the work. Changes in aggregate or asphalt sources will necessitate a new job mix calibration.
- b. Thoroughly dry the aggregate materials and proportion them together according to the job mix proposal. The more accurately these materials are proportioned together, the closer the calibration will be to the production mix; therefore, the more accurate the results.
- c. Weigh $7500 \text{ g} \pm 5 \text{ g}$ of dried aggregate into each of four pans, of the job mix gradation. Heat the aggregate and the asphalt cement to $135^\circ \pm 5^\circ\text{C}$ ($275^\circ \pm 10^\circ\text{F}$).

The 135°C (275°F) temperature is intended to approximate the mix that will be tested at the contractor's site. If there are going to be significant variations from this at the site, this temperature needs to be corrected.

- d. Place heated mixing bowl on balance and add one dry, hot aggregate sample and add hot asphalt at the job mix formula content + 0.4 percent, (pan No. 3) by mass (weight) of total sample.

$$\text{mass (weight) asphalt} = \frac{(\text{dry wt (mass) of agg}) (\text{JMF \%} + 0.4\%)}{100 - (\text{JMF \%} + 0.4\%)}$$

- e. Mix this material thoroughly. The mechanical mixers should take approximately three minutes. If the material cools during mixing without thorough coating, reheat and continue mixing.
 - f. Place all of the material from the mixing bowl on a piece of heavy paper or canvas and split out the required amount of the material to fill the sample pan.
 - g. Fill a heated nuclear sample pan approximately one-half full with mix at $135^\circ \pm 5^\circ\text{C}$ ($275^\circ \pm 10^\circ\text{F}$) and level it out with a putty knife or suitable tool. Do not compact.
 - h. Continue adding material to pan No. 3, adding enough material so that the mix is approximately 12.5 mm ($\frac{1}{2}$ in.) above the top of the pan. For the additional pans, add the material until the mass (weight) in the pan is within $\pm 5 \text{ g}$ of the blank mass (weight).
 - i. Immediately after filling the sample pan, place the metal plate or other flat object on the sample pan and compact the sample into the pan until it is level with the rim of the pan by standing or kneeling on the plate.
 - j. Weigh and record the mass (weight) of the mix in pan No. 3 as the blank mass (weight) on the job mix calibration work sheet. It is important that all future samples use this mass (weight).
- Note:** If an additional Nuclear Calibration is done for a Job Mix Design, the blank mass (weight) shall be the same as the original Job Mix Calibration unless problems arise with over filling or under filling the pan. If this occurs, a new blank mass (weight) will be determined.
- k. Recheck the mass (weight) of the mix in the pan to ensure that it is within $\pm 5 \text{ g}$ of the blank mass (weight).
 - l. Place the pan containing the asphalt mix in a 135°C (275°F) oven.

- m. Prepare the first, second, and fourth sample pans at the job mix formula content - 1.2 percent, -0.4 percent, and +1.2 percent. Follow steps d. through l. except *do not* adjust the blank mass (weight).
- n. Set the gauge to 16 minutes.
- o. Start the nuclear asphalt content gauge by pressing **CALIB** and follow the directions on the console for running a new calibration.
- p. Remove the samples one at a time from the 135°C (275°F) oven and immediately place the sample pans in the nuclear asphalt gauge. Record the results of each on the calibration work sheet.

5. CALCULATIONS

- a. After all samples have been measured, record the A1, A2, A3, the coefficient of fit, and the calculated percent difference for each pan. If either the fit coefficient is less than 0.995, and/or any single pan has a calculated percent difference greater than 0.09 percent, the calibration is not acceptable and will have to be redone.
- b. Review the calibration data and prepare a report.
- c. Distribute a copy of the Job Mix Calibration to each of the labs using the calibration: Olympia Service Center, Region, and Field.

16:P:DP/MM

WSDOT Test Method No. 722, Appendix 2

Method of Test for Cross Calibration of Nuclear Asphalt Content Gauge

1. SCOPE

- a. This method covers a procedure for the cross calibration of Troxler Model 3241C Nuclear Asphalt Content Gauges. The procedure utilizes six standard pans (sealed pans of known asphalt content) stored at the Headquarters Bituminous Laboratory. The cross calibration of gauges allows a job mix calibration performed on one gauge to be transferred to other gauges. This procedure will be generally done by headquarters lab personnel.

2. APPARATUS

- a. Troxler Model No. 3241C Nuclear Asphalt Content Gauges.
- b. Six sealed standard pans with known asphalt content kept in the FOSSC Materials Laboratory.

3. STANDARDIZATION

- a. The asphalt content gauge is sensitive to its surroundings. Be sure to locate the gauges in a place in the test lab where it will not need to be moved and where it will be away from water storage tanks and at least 9 (30 LF) m from other nuclear devices. Keep the top of the chamber free of all materials.
- b. Turn the console on and allow at least 15 minutes warm-up time after gauge indicates "ready."
- c. Set printer to "on" (press **SHIFT, AUTO**).
- d. Set the time to "16 minutes" (press **TIME**).
- e. Take a 16-minute background count with nothing in the chamber. Press **BKG** and follow the directions on the console for running a background count. Record the background count in the book provided with the nuclear asphalt content gauge. If the results vary by more than one percent (1 percent) from the previous recording, a new background count should be taken.

If conditions around the gauge change during the calibration, the testing should be stopped, and a new background count taken and the testing started over.

4. PROCEDURE

- a. Press "Calibration/New Calibration/Gauge Derived" on the console. Follow the directions on the console of the gauge.
- b. Enter the blank mass (weight) of the pans. (The predetermined mass (weight) of all the material in the pan.)
- c. Enter the number of pans which are six (6).
- d. Enter the percent asphalt for pan No. 1 which is 1.5 percent.
- e. Load Sample No. 1 into testing chamber and run a 16-minute count. Record the count on the form for cross-calibration.
- f. Repeat steps d. and e. for the remaining five pans at 3.0 percent, 4.5 percent, 6.0 percent, 7.5 percent, and 9.0 percent asphalt.

5. CALCULATIONS

- a. After all samples have been measured, record the A1, A2, A3, the coefficient of fit, and the calculated percent difference for each pan. If either the fit coefficient is less than 0.995, and or any single pan has a calculated percent difference greater than 0.09 percent, the calibration is not acceptable and will have to be redone.
- b. Record all values on the cross calibration form and record in the front of the field book supplied with the gauge.

17:P:DP/MM

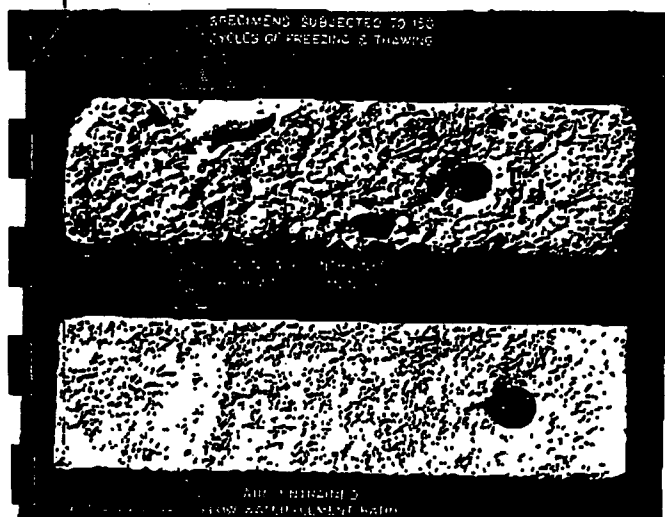


Fig. 1-8. Air-entrained concrete is highly resistant to repeated freeze-thaw cycles.

The water displaced by ice formation in the paste is accommodated so that it is not disruptive; the air bubbles in the paste provide chambers for the water to enter and thus relieve the hydraulic pressure generated.

When freezing occurs in concrete containing saturated aggregate, disruptive hydraulic pressures can also be generated within the aggregate. Water displaced from the aggregate particles during the formation of ice cannot escape fast enough to the surrounding paste to relieve pressure. However, under nearly all exposure conditions, a paste of good quality (low water-cement ratio) will prevent most aggregate particles from becoming saturated. Also, if the paste is air-entrained, it will accommodate the small amounts of excess water that may be expelled from aggregates, thus protecting the concrete from freeze-thaw damage.

Fig. 1-9 illustrates, for a range of water-cement ratios, that (1) air-entrained concrete is much more resistant to freeze-thaw cycles than non-air-entrained concrete, (2) concrete with a low water-cement ratio is more durable than concrete with a high water-cement ratio, and (3) a drying period prior to freeze-thaw exposure substantially benefits the freeze-thaw resistance of air-entrained concrete but does not significantly benefit non-air-entrained concrete.* Air-entrained concrete with a low water-cement ratio and an air content of 4% to 8% will withstand a great number of cycles of freezing and thawing without distress.

Freeze-thaw durability can be determined by laboratory test procedure ASTM C666, Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing. From the test, a durability factor is calculated that reflects the number of cycles of freezing and thawing required to produce a certain amount of deterioration. Deicer-scaling resistance can be determined by ASTM C672, Standard Test Method for Scaling Resistance of Concrete Surfaces Exposed to Deicing Chemicals.

Cycles of freezing and thawing to 25% weight loss

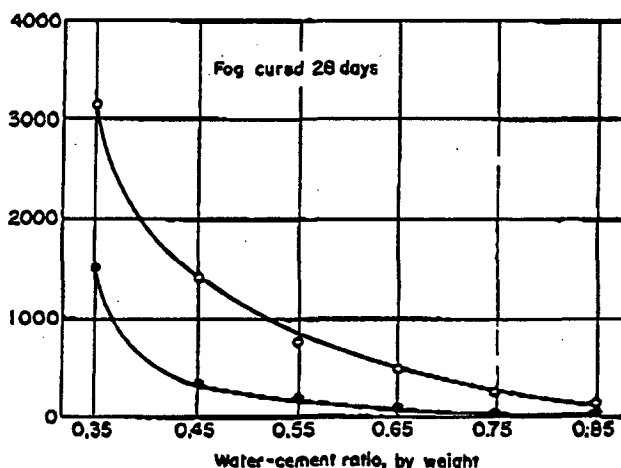
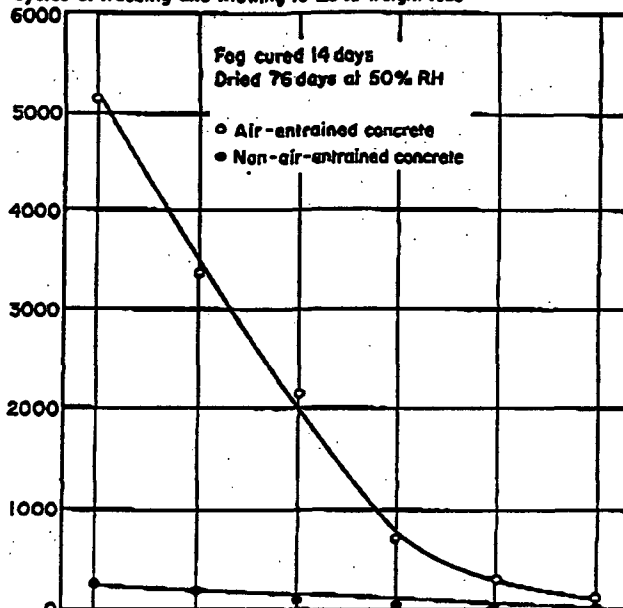


Fig. 1-9. Relationship between freeze-thaw resistance, water-cement ratio, and drying for air-entrained and non-air-entrained concretes made with Type I cement. High resistance to freezing and thawing is associated with entrained air, low water-cement ratio, and a drying period prior to freeze-thaw exposure. Reference 1-5.

Permeability and Watertightness

Concrete used in water-retaining structures or exposed to weather or other severe exposure conditions must be virtually impermeable or watertight. Watertightness is often referred to as the ability of concrete to hold back or retain water without visible leakage. Permeability refers to the amount of water migration through concrete when the water is under pressure or to the ability of concrete to resist penetration of water or other substances (liquid, gas, ions, etc.). Generally,

*See References 1-5 and 1-6.

the same properties of concrete that make concrete less permeable also make it more watertight.

The overall permeability of concrete to water is a function of the permeability of the paste, the permeability and gradation of the aggregate, and the relative proportion of paste to aggregate. Decreased permeability improves concrete's resistance to resaturation, sulfate and other chemical attack, and chloride-ion penetration.

Permeability also affects the destructiveness of saturated freezing. Here the permeability of the paste is of particular importance because the paste envelops all constituents in the concrete. Paste permeability is related to water-cement ratio and the degree of cement hydration or length of moist curing. A low-permeability concrete requires a low water-cement ratio and an adequate moist-curing period. Air entrainment aids watertightness but has little effect on permeability. Permeability increases with drying.*

The permeability of mature hardened paste kept continuously moist ranges from 0.1×10^{-12} to 120×10^{-12} cm per sec. for water-cement ratios ranging from 0.3 to 0.7.* The permeability of rock commonly used as concrete aggregate varies from approximately 1.7×10^{-9} to 3.5×10^{-13} cm per sec. The permeability of mature, good-quality concrete is approximately 1×10^{-10} cm per sec.

The relationship between permeability, water-cement ratio, and initial curing for 4x8-in. cylindrical concrete specimens tested after 90 days of air drying and subjected to 3000 psi of water pressure is illustrated in Fig. 1-10. The test apparatus is shown in Fig. 1-11. Although permeability values would be different for other liquids and gases, the relationship between water-cement ratio, curing period, and permeability would be similar.

Test results obtained by subjecting 1-in.-thick non-air-entrained mortar disks to 20-psi water pressure are given in Fig. 1-12. In these tests, there was no water leakage through mortar disks that had a water-cement

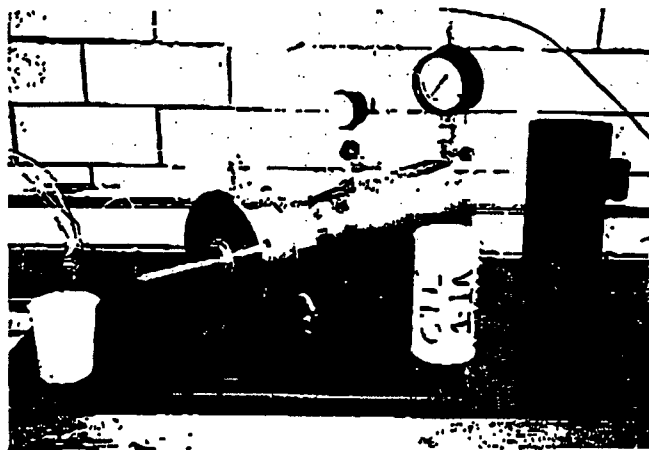


Fig. 1-11. Hydraulic permeability test apparatus used to obtain data illustrated in Fig. 1-10.

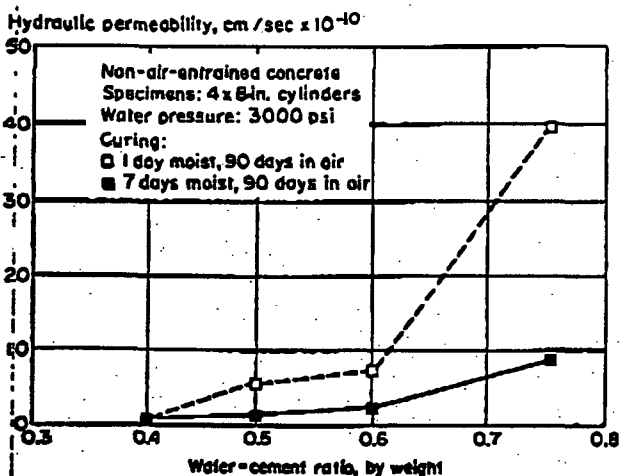


Fig. 1-10. Relationship between hydraulic (water) permeability, water-cement ratio, and initial curing on concrete specimens. Reference PCA HM1170.

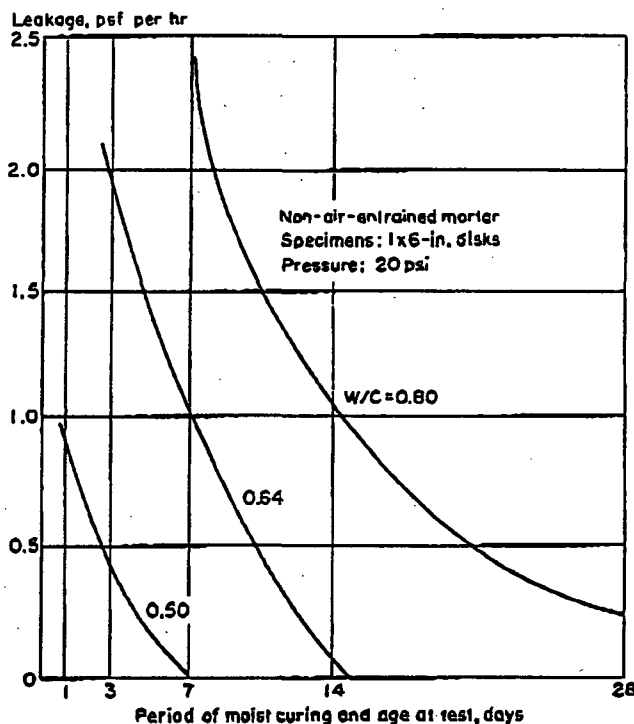


Fig. 1-12. Effect of water-cement ratio (w/c) and curing duration on permeability of mortar. Note that leakage is reduced as the water-cement ratio is decreased and the curing period increased. Reference 1-1 and PCA Major Series 227.

ratio of 0.50 by weight or less and were moist-cured for seven days. Where leakage occurred, it was greater in mortar disks made with high water-cement ratios. Also, for each water-cement ratio, leakage was less as the length of the moist-curing period increased. In disks with a water-cement ratio of 0.80, the mortar still

*Reference 1-4.

permitted leakage after being moist-cured for one month. These results clearly show that a low water-cement ratio and a period of moist curing significantly reduce permeability.

A low water-cement ratio also reduces segregation and bleeding, further contributing to watertightness. To be watertight, concrete must also be free from cracks and honeycomb.

Occasionally, porous concrete—no-fines concrete that readily allows water to flow through—is designed for special applications. In these concretes, the fine aggregate is greatly reduced or completely removed producing a high volume of air voids. Porous concrete has been used in tennis courts, pavements, parking lots, greenhouses, and drainage structures. No-fines concrete has also been used in buildings because of its thermal insulation properties. Additional information on porous concrete is given in Chapter 15, "Special Types of Concrete."

Abrasion Resistance

Floors, pavements, and hydraulic structures are subjected to abrasion; therefore, in these applications concrete must have a high abrasion resistance. Test results indicate that abrasion resistance is closely related to the compressive strength of concrete. Strong concrete has more resistance to abrasion than does weak concrete. Since compressive strength depends on water-cement ratio and curing, a low water-cement ratio and adequate curing are necessary for abrasion resistance. The type of aggregate and surface finish or treatment used also have a strong influence on abrasion resistance. Hard aggregate is more abrasion resistant than soft aggregate and a steel-troweled surface resists abrasion more than a surface that is not troweled.

Fig. 1-13 shows results of abrasion tests on concretes of different compressive strengths and aggregate types.

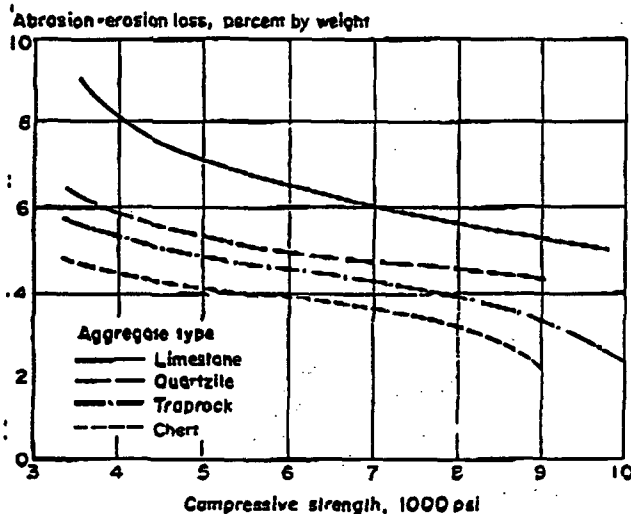


Fig. 1-13. Effect of compressive strength and aggregate type on the abrasion resistance of concrete. High-strength concrete made with a hard aggregate is highly resistant to abrasion. Reference 1-16.

Fig. 1-14 illustrates the effect hard steel troweling and surface treatments have on abrasion resistance. Abrasion tests can be conducted by rotating steel balls, dressing wheels, or disks under pressure over the surface (ASTM C 779). One type of test apparatus is pictured in Fig. 1-15. Other types of abrasion tests are also available (ASTM C 418 and C 944).

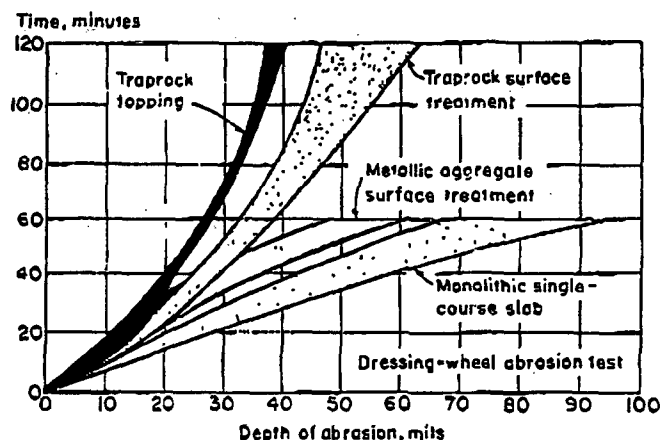


Fig. 1-14. Effect of hard steel troweling and surface treatments on the abrasion resistance of concrete. Base slab compressive strength was 6000 psi at 28 days. All slabs were steel troweled. Reference 1-12.

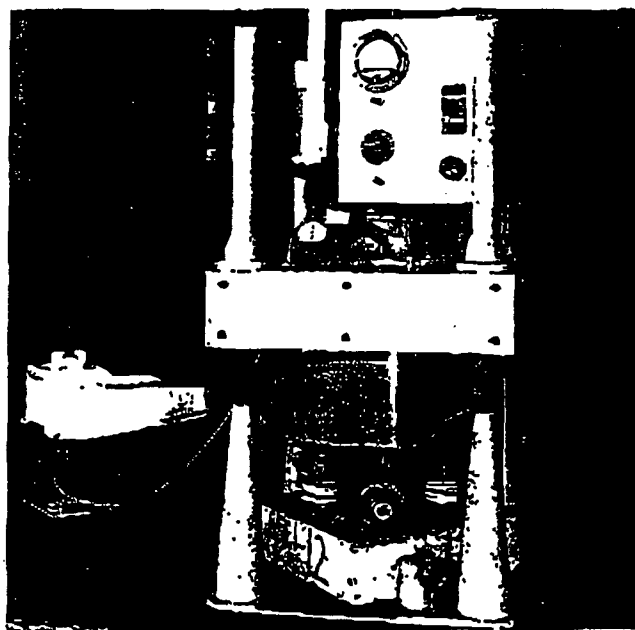
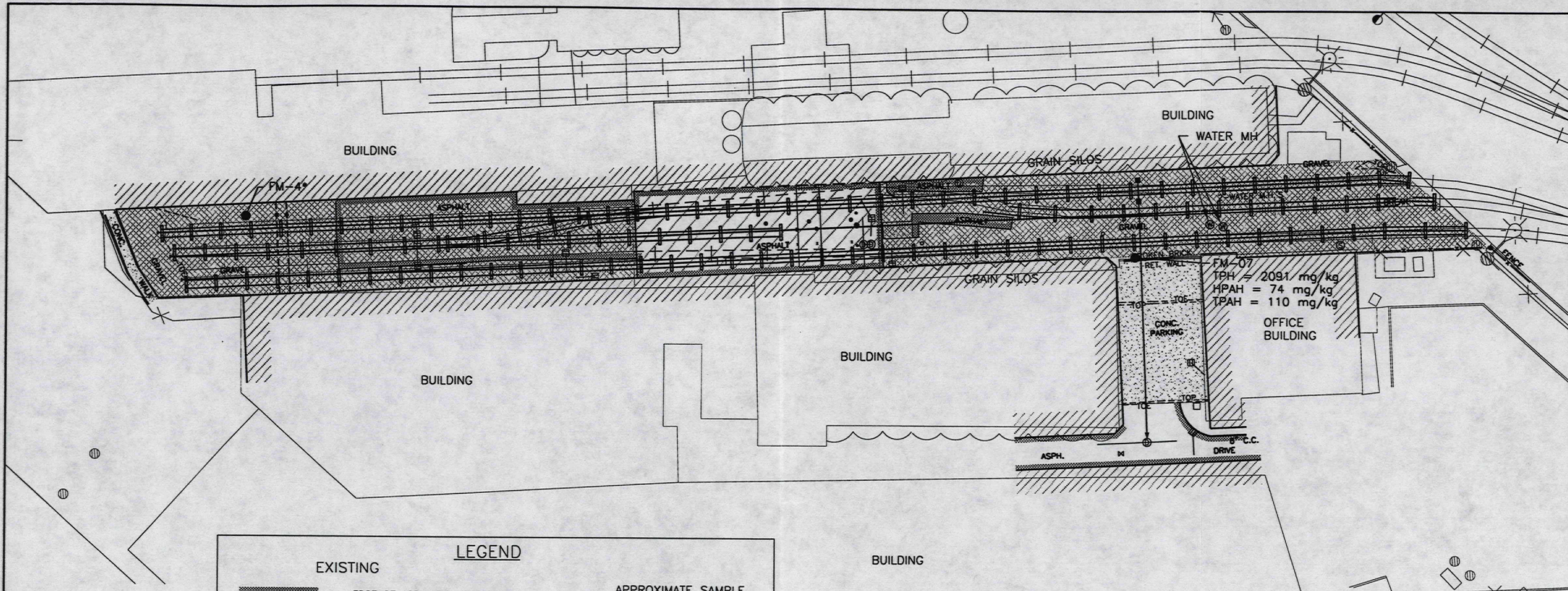


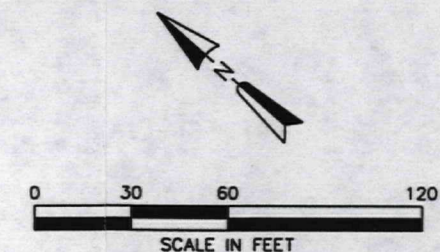
Fig. 1-15. Test apparatus for measuring abrasion resistance of concrete. The machine can be adjusted to use either revolving disks or dressing wheels. With a different machine, steel balls under pressure are rolled over the surface of the specimen. The tests are described in ASTM C 778, Standard Test Method for Abrasion Resistance of Horizontal Concrete Surfaces.



LEGEND

EXISTING			
	EDGE OF ASPHALTIC CONCRETE		APPROXIMATE SAMPLE LOCATION
	CATCH BASIN		LIGHT POLE
	CONCRETE CURB		CATCH BASIN
	CONCRETE SURFACE		MANHOLE
	FENCE LINE		
	INVERT ELEVATION		
	IRON PIPE		
	RAILROAD TRACKS		
	SANITARY SEWER MANHOLE		
	STORM DRAIN		
	STORM DRAIN MANHOLE		
	WATER VALVE		
	WATER MANHOLE		
	BUILDING FOUNDATION LINE NOTE: BUILDING FACE JOGS IN SEVERAL AREAS ALONG THIS LINE		
PROPOSED			
	NEW CL. B ACP		
	NEW REINF. CONCRETE		

* CONSTITUENT CONCENTRATIONS IN
SAMPLE WERE BELOW EPA CAPPING
CRITERIA.



SOURCE: DAVID EVANS AND ASSOCIATES, TACOMA, WA

REFERENCE DWG	DESCRIPTION	NO	DRWN	DATE	REVISION	CHKD	DATE	APPVD	DATE
0	E.F.	6/27/97	DRAFT						
1									
2									
3									
4									
5									
6									

HARBOR ISLAND S&GOU
SUPERFUND SITE, SEATTLE, WA
1-2900-625

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CURRENT DATE: 6/27/97 CAD FILE: 2900S075

PROPOSED CAPPING AREA
FISHER MILLS INC

RETEC
REMEDIATION
TECHNOLOGIES INC
DRAWING NO. 3-5
REV 10

These areas will then be graded to the depths shown in the design drawings. Grading will be accomplished by minimizing the volume of soil removed yet still providing a drainage design so storm water runoff will flow to the existing storm drain system. Soil removed during subgrade preparation will be stockpiled in a designated area on plastic sheeting or in roll-off containers and covered to keep it dry and prevent erosion. ACP and PCCP removed during subgrade preparation activities will be stored separately from the site grading soil. Soil from around sample location FM-07 will be removed and stockpiled separately. This area of soil to be separated will be 10 feet by 10 feet unless other visual or olfactory evidence of impacts are noted.

Storm Drain System Improvements

The storm drain system will be upgraded as shown on the design drawings to collect and discharge stormwater from EPA-required capping areas. Several new catch basins and slot drains will be added to improve drainage. These improvements will discharge to the existing storm drain system.

Subgrade and Storm Drain Soil Disposition

Representative composite samples will be taken from the stockpiled soil for disposition profiling purposes. A single composite sample will be collected from the FM-07 stock pile and composite samples will be taken every 200 cubic yards from the remaining soil stockpile. Based upon analytical results, the soil will be transported to the appropriate receiving facility or wasted on the north side of the site, where it will be covered with gravel if necessary. ACP and PCCP removed during site preparation will have any soil or staining removed and will be wasted on the north side of the property. Sample FM-07 exceeded capping criteria for TPH and PAHs.

Base Course

A minimum of 4 inches of CRBC per WSDOT specifications will be used as base course in all areas between rails. A minimum of 6 inches of railroad ballast will be placed beneath the railroad ties. Placement of CRBC and railroad ballast will be accomplished in accordance with WSDOT specifications.

Capping

The cap in the area around the tracks up to the edges of the buildings will consist of a minimum 3-inch layer of ACP per WSDOT specifications and EPA requirements. Final grade will match existing grades and will direct surface flow to storm drains.

The parking lot area will also be finished with a minimum 3-inch layer of ACP per WSDOT specifications. The final grade will match the existing grade to the south and will drain to the existing catch basin in the parking lot.

3.2.5 Former Lone Star Northwest Property

The remedial action for this property will consist of capping the 50 foot strip of soil running east to west along the northern property boundary between the former Lone Star Northwest property and the Port of Seattle property. The width of this strip of soil ranges from 3.5 to 6 feet. An additional asphalt overlay (approximately 20 feet by 20 feet) will be placed near the southeast corner of the office building.

Design Rationale

Four samples were originally collected from this property at locations shown in Figure 3-6. Two of the four samples were recorded in the EPA Sampling Summary (EPA, 1994). These samples exceeded capping criteria for arsenic and TPH.

Sample, PS-1, was taken from a small strip of soil 3 to 4 feet wide running along the north property boundary. The area to the south of the strip of exposed soil is composed of suitable PCCP. The area to the south of the existing PCCP area is similar to the area where sample PS-3 was collected; sample PS-3 did not exceed capping criteria. This area was formerly capped with PCCP. Two additional samples were collected and analyzed on April 29 for arsenic by EPA-CLP laboratory analysis to further delineate the extend of the proposed capping area. Both samples were below arsenic capping criteria. Two soil samples were also collected on June 19 to verify arsenic data collected by Olympic Tug and Barge. These samples were collected east of the maintenance shed and were below arsenic capping criteria.

Sample, PS-2, was taken near the east edge of the property near the waterway. Constituent concentrations in this sample were also below capping criteria. This sample was taken in fill that has been moved onto the site following the departure of Lone Star Northwest. The gravel in this area appears to have come from the same source.

Sample, PS-4, was taken on the south end of the site near the Duwamish Waterway. This sample contained TPH above capping criteria. However, the precise location of this sample cannot be pinpointed due to site redevelopment in the area around the approximate sample location. This area is completely capped with suitable PCCP and dermal contact with the native soil is not

possible. A field log completed during the collection of PS-4 indicates the sample may have been obtained along the fence line near the southeast property boundary at the edge of the existing concrete slab. An asphalt overlay will be placed over a small area of suitable PCCP to cover a location of minor cracking.

The other area to be capped on this property is the strip of soil where sample PS-1 was collected. Capping will begin at the west property boundary and head east along the north property boundary to the shoreline area shown in Figure 3-6.

Site Preparation

Currently, various materials (i.e., old machine parts, scrap iron, etc.) are located on the strip of soil to be capped. Prior to beginning subgrade preparation, the material will need to be relocated away from capping activities by either the property manager or the by the Contractor under direction of the property manager.

Site and subgrade preparation prior to capping will include removing the surficial soil from the strip to a depth of approximately 7 inches below ground surface (bgs). Soil removed during subgrade preparation will be stockpiled in a designated area on plastic sheeting or in a roll-off container and covered to keep it dry and prevent erosion.

Subgrade Soil Disposition

Once the subgrade is prepared, a representative composite sample will be taken from the stockpiled soil for disposition profiling purposes. Based upon analytical results, the soil will be transported to an appropriate receiving facility. The soil may be combined with soil from other 1B sites prior to transportation to the receiving facility to reduce the cost of final disposition. This will be dependent upon the soil profiling results. Sample PS-01 collected from this location exceeded capping criteria for arsenic.

Base Course

Four (4) inches of CRBC per WSDOT specifications will be used to backfill the excavation to 3 inches below grade. Placement of CRBC will be accomplished in accordance with WSDOT specifications and quality control requirements discussed in Section 5.

Capping

The cap will consist of a 4-inch layer of PCCP per WSDOT specifications and EPA requirements. Quality control requirements are discussed in Section 5. The top of the new PCCP surface will match the existing adjacent grade to the south.

The overlay will consist of ACP. The thickness of this layer will be defined during mix design testing as the minimum ACP thickness that satisfies the permeability criteria, with a minimum thickness of 1 inch. Paving fabric or other means shall be used to prevent reflective cracking.

3.3 Cost Estimate

Remedial Construction and contractor oversight and inspection costs have been approximated for each of the 1B properties. Each site includes stand-alone estimated costs without taking into account economies of scale that may exist by utilizing one contractor to perform remedial activities at all sites. In some cases materials handling is based on a lump sum amount due to certain fixed costs in relation to the small quantities. Table 3-1 summarizes the construction and oversight costs for each 1B Participant site.

Table 3-1 Estimated Capping Costs

Work Scope	Fisher Mills	UPRR	Aspen Paints	Former Lone Star Northwest	Harbor Island Machine Works
Mobilization, site preparation	20,000	1,000	1,000	1,000	1,000
Subgrade preparation, CRBC, ACP/PCCP cap ^A	150,000	1,500	2,800	2,000	4,000
Soil stockpiling, loading, transportation and disposal ^B	5,000	1,000	1,500	1,200	1,500
Construction Costs	175,000	3,500	5,300	4,200	6,500
Construction oversight	5,000	1,500	1,500	1,500	1,500
Testing/profiling	2,500	1,000	1,000	1,000	1,000
Completion reporting	<i>Not Included</i>				
Oversight/Testing	7,500	2,500	2,500	2,500	2,500
Total	\$182,500	\$6,000	\$7,800	\$6,700	\$9,000

NOTES:

^A Based on a minimum paving charge of \$500 per small area or \$4.50 per square foot CRBC and ACP.

^B Transportation and disposal at a subtitle D facility or equivalent.

4 Design Activities

This section discusses the design team structure and the activities associated with preparation of the design documents for the 1B properties. The design process and the associated design documents are discussed below. A brief discussion of the remedial action bid document is also presented.

4.1 Project Design Team Roles, Responsibilities and Authority

The overall project design team structure is shown in Figure 4-1. This figure provides an organizational chart showing the relationship of the design team with respect to the S&G OU Coordinating Contractor, Project Coordinators, S&G OU Steering Committee and EPA.

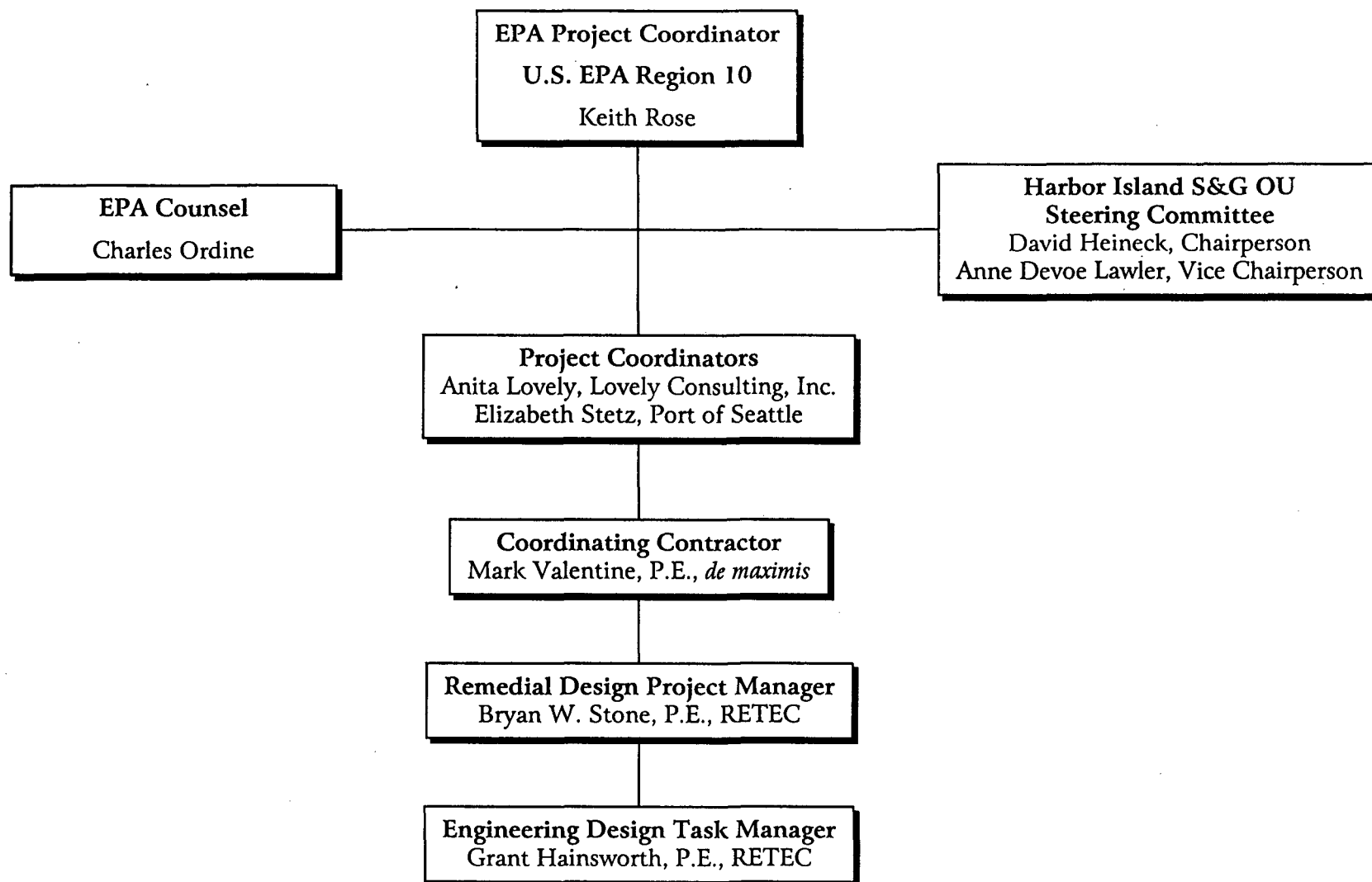
4.2 Design Documents

As stated in the RDWP, Design Set 1B consists of only two design phase submittals. The first submittal is a combined preliminary and draft final design (i.e., combined 30% and 95% designs) followed by a second final design (100% design). The design packages will be submitted in this manner to expedite design approval and allow capping to be completed in 1997. However, as discussed in the RDWP, a technical memorandum that described specific basis of design information related to capping areas, cap designs, etc., was submitted prior to this submittal. The 30 Percent Technical Memorandum did not contain all of the items identified in the RDWP as required in the 30 percent design. Those other items are described in the subsequent section. The two design packages identified are presented below. The submittals required for each stage of the design are also included. A detailed description of the engineering plans and specification sections is presented in Section 4.3.

4.2.1 Combined Preliminary and Draft final Design (30% and 95%)

Submittals included with this design package consisted of the draft final version of all preliminary design documents. This design package incorporated EPA's comments on the 30 Percent Technical Memorandum. A complete set of draft construction plans were provided in full-size format, on 24-inch by 36-inch paper, along with accompanying construction specifications. Plans and information in the combined design package included:

Figure 4-1 Remedial Design Team Key Personnel



- Updated Site Maps
- Site Topographical Surveys, where required
- Grading and Storm Drainage Design
- Draft Construction Specifications
- Draft Bid Forms
- Description of Ra Work/Field Operations
- Constructability Review
- Draft Final Construction Schedule (including bidding)
- Statement of Intent to Implement All Plans
- Draft Permit Compliance Plan
- Draft Construction Quality Assurance Plan (CQAP)—the following draft plans and information will also be included in the CQAP:
 - Identify RA team for construction management, key personnel and roles
 - RA contractor qualifications and procurement
 - Description of all RA roles and responsibilities
 - Requirement for project closeout and as-builts
 - Quality assurance procedures
 - Contingency procedures
 - Change order process

4.2.2 Final Design (100%)

The final design submittal consists of the final version of all draft final design documents and plans with EPA's comments on the 95 percent submittal incorporated. The final design includes full-size detailed plan sheets, construction contract duration and schedule requirements, and specifications adequate to implement the remedy. The quality of the final design document is such that it will be the basis for the bid package that invites contractors to submit bids for the construction project(s).

4.3 Plans and Specifications

The capping design for the 1B properties consists of the plans and specifications listed below.

4.3.1 Design and Bid Plans

- Title Sheet (T-1)
- General Site Plan, Legend, Abbreviations and Notes (C-1)
- Grading and Paving Plan and Details - Aspen Paints (C-2)
- Grading and Paving Plan and Details - Union Pacific Railroad (C-3)
- Grading and Paving Plan and Details - Harbor Island Machine Works (C-4)

- Grading and Paving Plan and Details - former Lone Star Northwest (C-5)
- Track and Drainage Improvements - Fisher Mills, Inc. (Sheets 1 through 7 prepared by David Evans and Associates, Inc.)

4.3.2 Bid Scope of Work

The requirements for performance of this work will be provided to bidding contractors as a scope of work rather than detailed specifications prepared in Construction Specifications Institute (CSI) format. The following requirements will be detailed in this scope of work.

General Requirements

Instructions to Bidders

This section includes general requirements and information for potential contractors to follow during the bidding process.

Compliance with S&G OU Consent Decree (CD)

Requirements stated in the CD are restated here to be followed by the selected contractor.

Summary of Work

A summary of the work to be completed by the contractor is presented. This describes work for each individual property .

Health and Safety Requirements

A summary of Health and Safety Requirements is presented. It defines when OSHA-trained workers are required (see Section 5.2).

Decontamination

This section discusses equipment decontamination requirements to be followed by the contractor upon completion of subgrade preparation or other native soil handling activities.

Quality Control, Testing Laboratory Services

ACP and PCCP testing requirements and base course testing requirements are presented.

Project Record and As-builts

Information gathered during construction that the contractor will be required to provide the Oversight Engineer upon completion of work.

Site Work Requirements

Clearing, Grubbing and Cleanup

This specification presents a description of removal of materials stored on site, and removal of debris and vegetation in preparation to grading.

Subgrade Preparation

Specifications relating to removing subgrade soil and grading to subgrade are presented.

Handling, Transportation, and Final Disposition of Stockpiled Material

This specification describes the process for disposition of soil removed during site preparation activities.

Stormwater and Decontamination Water Handling

Includes a description of the process for protection of existing storm drain systems and disposition of water collected during decontamination and storm events.

Storm Drain Systems

This specification is applicable to only those sites requiring storm drainage systems or improvements. It includes specifications for upgrading and installing the necessary storm drainage system components.

Base Course

Includes a description of the thickness and compaction of base course required and QC testing associated with its placement.

Asphalt Concrete Pavement

Includes of description of the type of ACP required and QC testing associated with application.

Portland Cement Concrete Pavement

Includes of description of the type of PCCP required and QC testing associated with application.

4.4 Bidding and Contracting

A single design document, including drawings and scope of work associated with each 1B property has been prepared for all 1B participants to use for construction bidding purposes. It contains a separate bid form for each 1B site. The 1B participants may then choose to bid work collectively or independently, as they choose during contractor procurement and performance of work.

5 Quality Control

This section discusses the quality control for the project, including the quality control structure, responsibilities, and requirements. Quality control requirements include ensuring compliance with health and safety requirements and contract performance standards.

5.1 Quality Control Structure

The Oversight Engineer will institute a system for quality control, inspections and tests, and retesting of work if necessary. This will be accomplished to ensure compliance with contract provisions and established performance standards.

Figure 5-1 provides an organization chart for quality control oversight during grading and capping activities. The Oversight Engineer will be responsible for ensuring compliance with the Performance Standards outlined in Section 5.2. Repeated deficiencies will result in project shutdown until the Remedial Contractor's performance has been adequately corrected.

Once capping activities are completed, the Oversight Engineer will submit a final completion report with as-built drawings identifying the prime and subcontractor personnel and equipment on site, work accomplished, materials used, inspections and tests conducted, results of inspections and tests, nature of defects found, reasons for rejection (if any), and corrective actions taken.

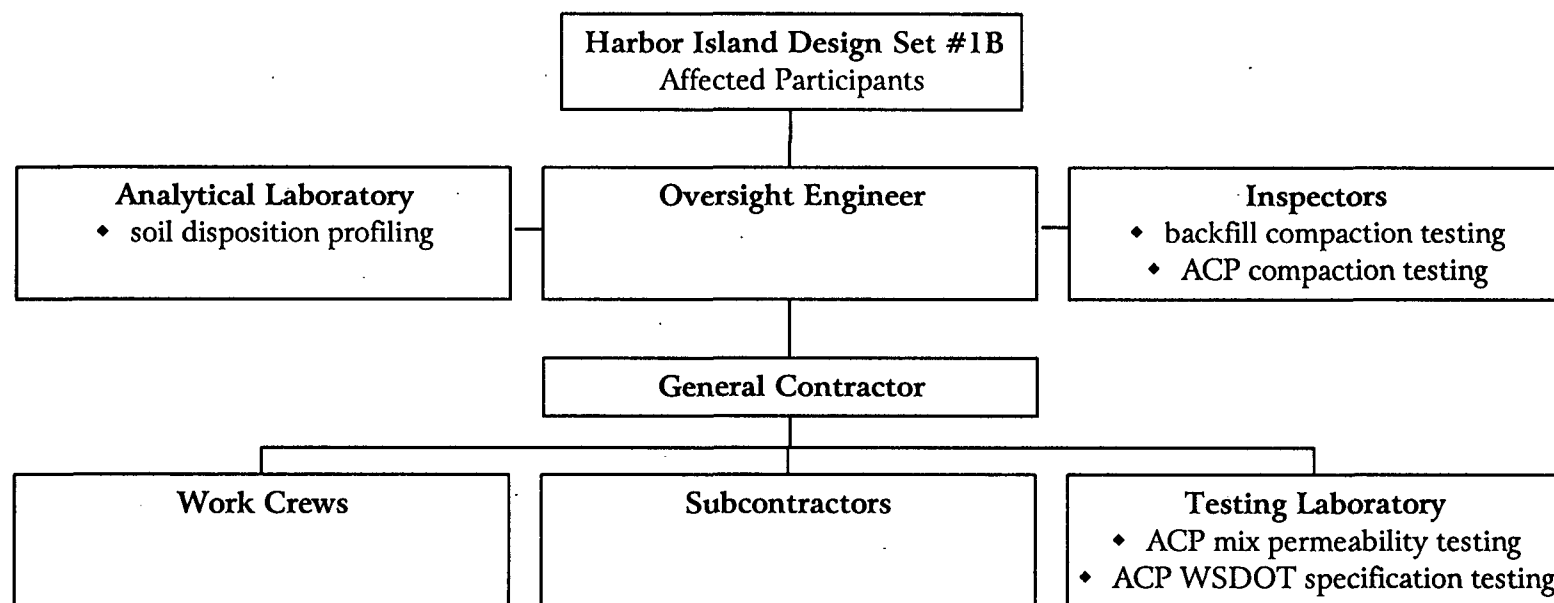
5.2 Quality Control Requirements

5.2.1 Health and Safety

For work that does not disturb native soil, the contractor is not required to have workers trained for hazardous waste work. For contractors who will be conducting site preparation work (such as earthwork or grading) in native soil the following requirements are applicable.

The Remedial Contractor shall be required to meet all the requirements of Washington Administrative Code (WAC) 296-155, Safety Standards for Construction and the applicable provisions of the hazardous waste operations regulations, WAC 296-62, Part P and 29 CFR 1910.120. The contractor shall also have a site health and safety (H&S) officer who will ensure that contractor personnel adhere to H&S regulations. Prior to starting work, the contractor shall submit their own HASP for review by the Oversight Engineer and EPA. The plan

Figure 5-1 Quality Control Organization Chart Design Set 1B



shall also include written documentation of employee training and medical certifications as required under WAC 296-62, Part P. Documentation of the following items is required for each site worker where work falls under the requirements of WAC 296-62, Part P:

- Initial 40-hour health and safety training and annual 8-hour refresher training
- Eight-hour supervisory training, required for the field supervisor
- Medical clearance from a licensed physician certifying that the worker is fit to participate in field activities and use personal protective equipment
- Current respirator fit test certification
- Current CPR and first aid certification for at least one member of each crew
- Provision of personal protective equipment for each worker at the highest level of protection for this site

5.2.2 Performance Standards

Performance standards address environmental and public health issues, such as emission and noise control; soil transportation, disposition, and recycling; and compliance with environmental regulations. Monitoring efforts of the Oversight Engineer will be conducted to ensure compliance with performance standards.

The following is a preliminary identification of performance standards for capping activities at the 1B properties. Table 5-1 lists the various performance standards and the contractor quality assurance testing requirements.

Emission Controls

Grading and capping activities will be carried out in a manner that minimizes emissions of odors and dust (fugitive emissions). Grading and capping activities will comply with the PSAPCA air quality standards and controls found in Table 5-1. The contractor shall provide measures to suppress any fugitive dust generated during site grading that exceed Section 9.15, Regulation I criteria. The Oversight Engineer will monitor the on site activities to ensure compliance with these standards and regulations.

Table 5-1 Performance Standards, Harbor Island S&G OU

Standard	Parameter	Level of Performance	Testing Method or Specification	Frequency of Testing	Comments
Emission Controls	Dust	Section 9.15 PSAPCA Regulation I	Visual	Continuous	Contractor shall provide dust suppression measures.
Noise Control	Exceedance of maximum permissible sound levels	RCW 70.107 SMC Title 25.800	None	None	Work shall only occur during daylight hours. Sites are in industrial areas with no domestic dwellings nearby.
Criteria for Off-site Shipment	Stockpiled soil	Subtitle D waste Subtitle C waste Remain on site	Analytical results <DW Criteria Analytical results >DW Criteria None	Every 200 cubic yards, and a minimum of once per property	Soil remaining on site may be used as fill material and capped in accordance with EPA capping requirements, or stored until such time.
	Asphalt debris	Subtitle C waste Recycling facility or Subtitle D	Analytical results >DW Criteria Analytical results <DW Criteria	Every 200 cubic yards, and a minimum of once per property	Asphalt will not be tested for TCLP metals if capping is required for previous detection of organic constituents only.
	Concrete debris	Subtitle C waste Recycling facility or Subtitle D	Analytical results >DW Criteria Analytical results <DW Criteria	Every 200 cubic yards, and a minimum of once per property	Concrete will not be tested for TCLP metals if capping is required for previous detection of organic constituents only.
	Vegetation	Subtitle D waste	None	None	Vegetation cleared from site during clearing and grubbing shall be sent to receiving facility with soil sent off site.
	Decontamination Water	Receiving facility requirements	TPH by EPA Method 418.1 PAH by EPA Method 8270 Metals by EPA Method 6010	Once per container	Decontamination water shall be sent to an EPA-approved TSD facility. Testing will only be done for those constituents that were previously detected in the soil.

Table 5-1 Performance Standards, Harbor Island S&G OU (Continued)

Standard	Parameter	Level of Performance	Testing Method or Specification	Frequency of Testing	Comments
Subgrade Preparation	Compaction in fill areas	95 percent maximum standard density	WSDOT Method 613	Once per capping area	Any layer of subgrade fill material shall not exceed 8 inches in depth without compaction. Subgrade fill only anticipated at Fisher Mills.
	Compaction in cut areas	To satisfaction of Oversight Engineer	None	None	Compaction in cut areas shall consist of a minimum of two passes over area with a vibratory roller.
Base Course	Gradation	WSDOT crushed surfacing base course	WSDOT 9-03.9(3)	For each source	
	Los Angeles wear, 500 rev	35% maximum	WSDOT Test Method 131	For each source	
	Degradation factor, base course	15% minimum	WSDOT Test Method 113	For each source	
	Compaction	95 percent maximum standard density	WSDOT Method 613	Once per capping area or every 100 square yards, whichever is smaller	Any layer of base course material shall not exceed 4 inches in depth without compaction.

Table 5-1 Performance Standards, Harbor Island S&G OU (Continued)

Standard	Parameter	Level of Performance	Testing Method or Specification	Frequency of Testing	Comments
ACP Cap	Aggregate gradation	WSDOT Class B	WSDOT 9-03.8(6)	For each source	
	Los Angeles wear, 500 rev	30% maximum	WSDOT Test Method 131	For each source	
	Degradation factor, wearing course	30% minimum	WSDOT Test Method 113	For each source	
	Cohesion value	100 minimum	WSDOT Test Method 719	For each source	Contractor to submit optimum densities for each mix design to be used by Field Inspectors for compliance.
	Modified Lottman stripping test	PASS	Modified Lottman	For each source	
	Asphalt content (AR 4000)	4.0–7.5%	WSDOT 718	For each source	
	Stabilometer value	35 minimum	WSDOT Test Method 722	For each source	
PCCP Cap	Percent voids	2.0–4.5	ASTM D3637	For each source	
	Permeability (non-destructive)	1×10^{-5} cm/s maximum	ASTM D2726	For each source	
	Maximum standard density	Rice density	WSDOT Method 705	For each source	
	Materials	WSDOT Class B	WSDOT 5-05.3(1)	For each source	

NOTES:

DW Criteria - Dangerous Waste Criteria taken from MTCA 173-303.

Analytical Results from samples taken from stockpiled soil, asphalt, or concrete debris. Samples will only be analyzed for those constituents previously found at levels greater than capping criteria.

Noise Control

Noise will be monitored within the construction area by the Oversight Engineer. All 1B sites are located in an industrial area and all work will most likely be conducted during daylight hours, thus no excessive noise will be generated that may be regulated under SMC.

Criteria for Off-site Shipment of Material

Material resulting from subgrade preparation activities that shall be shipped off site for recycling or disposal must meet certain criteria depending on its type and final use. Types of material include: soil, asphalt debris, concrete debris, and vegetation. The categories of end use include recycling/reuse, solid waste disposal, and possibly dangerous waste disposal, although none is anticipated. These criteria must be achieved by the contractor as confirmed through compliance monitoring performed by the Oversight Engineer. Table 5-1 indicates the procedure that will be used to determine if off-site shipment criteria have been achieved. All dangerous waste disposal facilities must be EPA approved.

Decontamination Water Disposal Criteria

Water resulting from decontamination of equipment or personnel shall be shipped off site for final disposition depending on its chemical profile. For purposes of bidding, contractor shall assume water disposal at a TSD facility. The Oversight Engineer will be responsible for profiling and disposal of decontamination water. Table 5-1 indicates the procedure that will be used to determine if off-site shipment criteria have been achieved. Decontamination water must be taken to an EPA-approved treatment, storage and disposal facility (TSD).

Subgrade Preparation Specifications

The contractor shall be required to prepare the subgrade for base course and capping per WSDOT standard specifications. All subgrade will be compacted to a depth of 7 inches if capping is ACP or 8 inches if capping is PCCP. Table 5-1 provides additional information for subgrade preparation.

Base Course Specifications

The contractor shall be required to backfill the areas to be capped with clean, granular fill. Backfilling shall be performed in accordance with specifications for construction per WSDOT standard specifications. Table 5-1 provides testing frequency and additional requirements for the minimum allowable base course. All materials, work, quality control, and quality standards for this specification shall be performed in accordance with and shall meet the requirements of the pertinent sections of the WSDOT Standard Specifications, current edition.

Handling, hauling, placing and compacting of base course shall be done in accordance with the applicable sections of the WSDOT Standard Specifications. Placement will be to dimensions and grades indicated on drawings included in Attachment A or as directed by the Oversight Engineer.

ACP Cap Specification

The two requirements for the capping remedy as previously stated for ACP include:

- **Thickness:** 3 inches minimum
- **Permeability:** 1×10^{-5} cm/sec maximum

Prior to starting work, the contractor shall provide a submittal containing an ACP mix design with supporting permeability testing data demonstrating the proposed mix meets both pavement permeability criteria and WSDOT specification. The submittal shall also include contingency measures for noncompliance with performance standards. This submittal shall be submitted for review and approval by the Oversight Engineer prior to mobilization.

Table 5-1 provides testing frequency and additional requirements for the minimum allowable ACP section and base course. All materials, work, quality control, and quality standards for this specification shall be performed in accordance with and shall meet the requirements of the pertinent sections of the WSDOT Standard Specifications, current edition. Additional tests, including destructive tests, may be added at the discretion of the Oversight Engineer to evaluate compliance with performance standards.

Mixing, handling, batching, hauling, placing, rolling and compacting ACP shall be done in accordance with the applicable sections of the WSDOT Standard Specifications except that the thickness of the ACP course shall be 3 inches. Placement shall be to dimensions and grades indicated on drawings included in Attachment A or as directed by the Engineer.

Required tack coats shall be applied in accordance with applicable sections of WSDOT Standard Specifications.

All joints to existing asphalt shall be butt joints as per WSDOT Standard Specifications; use of other joint types must be approved by engineer.

PCCP Cap Specification

The two requirements for the capping remedy as previously stated for the cap include:

- **Thickness:** 3 inches minimum
- **Permeability:** 1×10^{-5} cm/sec maximum

Any PCCP cap must meet the requirements above. Permeability of mature, good quality concrete is approximately 1×10^{-10} cm/sec (Portland Cement Association, Pub EB001). Based on this information no permeability testing for PCCP will be required prior to placement.

Construction of a PCCP cap shall be performed in accordance with specifications for construction per WSDOT standard specifications. All materials, work, quality control, and quality standards for this specification will be performed in accordance with and shall meet the requirements of the pertinent sections of the WSDOT Standard Specifications, current edition.

Placement shall be to dimensions and grades indicated on drawings included in Attachment A or as directed by the Engineer.

5.2.3 Record Keeping and Reporting

The Oversight Engineer will maintain records to document the work performed. These records include, but are not limited to, the following:

- **Daily Activity Log.** A daily activity log will be completed to describe general site activity and personnel working on site. The records may be used to substantiate invoices as related to measurement and payment of site work. Health and Safety levels will also be noted in the daily logs as well as field H&S monitoring.
- **Sample Collection Log.** Records of all samples collected will be maintained. Samples will be collected from any soil stockpiled for characterization and final disposition purposes, and from any decontamination water that has been collected and stored. Sample collection logs will include, at a minimum, the date and time of sampling, sample location, medium and characteristics of medium sampled, identification of sampler, analysis requested, analytical results, plus any additional relevant comments. A record of all laboratory data reports and sample chain-of-custody documentation will be maintained.
- **Material Testing Results.** Records of all permeability and compaction tests will be maintained. Material testing logs will, at a minimum, include the date and time of testing, testing site and location, identification of tester and company, test results, and any relevant comments.

- **Off-site Tracking Form.** A continuous log of all off-site shipments and manifests which includes the following information: type of material, source of material, day shipped, receiver, weight, and usage restrictions.

5.3 Permit Compliance Plan

Application for permits normally required for this site work will not be necessary given the Superfund site status, although the substantive requirements of such permits will be followed.

City of Seattle Department of Construction and Land Use shoreline and grading permits normally would be required for some properties. The substantive requirements for both permits will be satisfied.

6 Cap Inspection and Maintenance

This plan details the inspection and maintenance (I&M) requirements for the ACP cap on the Design Set 1B properties. The purpose of this I&M Plan is to ensure future maintenance of the caps in a manner that complies with all of the objectives of the cap. The design components of the ACP cap are described in Section 3 of this document.

6.1 Cap Inspection and Maintenance Requirements

I&M requirements for the cap include notifications either to or from the property owners regarding repairs and/or maintenance efforts that penetrate the cap, cap inspections, and cap maintenance based upon inspection results, each of which is discussed below.

6.1.1 Notifications

Property owners must notify EPA prior to performing any site improvements that will impact the cap in areas where there is previously identified contaminated soil. Property owners must obtain EPA approval of plans for handling, storage, and disposal of contaminated soil. These plans must be in compliance with applicable environmental regulations.

6.1.2 Cap Inspections

The various caps will be visually inspected by the property owner annually or following any activities that disturb the cap. Following maintenance and repairs on the cap, inspections of the repaired areas will be performed semiannually for a year after the repairs have been conducted. After 10 years, additional monitoring requirements will be determined per agreement with EPA.

Surface conditions and conditions along structures are the two main components of the cap that will be visually inspected. The surface will be inspected for damage, settlement, and standing water. From these visual inspections, the integrity of the cap can be determined and any areas where maintenance is required can be identified.

Cap inspections examine how various site activities affect the integrity of the cap. Inspected areas and associated information will be noted on the inspection log provided in Figure 6-1.

6.2 Cap Maintenance

Based upon inspection results, any potential damage, settling or separation will be evaluated to determine if the item can be addressed by performing maintenance or repair to the cap. Table 6-1 presents the types of cap conditions that may develop over time and the maintenance or repair required.

Table 6-1 Maintenance Required Based Upon CAP Inspections

Inspection Item	CAP Condition	Maintenance Required
<i>Asphalt Concrete Pavement</i> Pavement Surface	Surface settlement <3 inches deep Surface settlement >3 inches deep	Surface patching Repair by removing asphalt and subgrade, replace subgrade and asphalt
<i>Notification by Tenant of Cap Damage</i>	Damaged area to be inspected within 5 working days of receiving tenant notification of damage	Repair/maintain as necessary

Conditions that may develop include settlement of the cap, water ponding on the asphalt surface, potholes that develop in the cap, or any damage reported by the property owner.

Every 5 years, the Design Set 1B property owners will evaluate the need to resurface the ACP. The property owners will then make recommendations as to the repairs necessary to maintain integrity of the working surface.

6.2.1 Surface Patching

Areas of settlement less than 3 inches deep will be patched. Surface patching will include brushing the area clean and placing standard asphalt to restore the settled area back to original grade. Standard asphalt patching will be placed in accordance current WSDOT standard specifications.

6.2.2 Removal/Replacement of Subgrade and Asphalt

Areas with settlement greater than 3 inches deep will require removal/replacement of asphalt and base course. Removal/replacement will include removing the existing ACP layer and removing the base course to a depth of 7 inches below existing grade. Base course and ACP will then be replaced to meet the original EPA specifications as provided in this document.

Material specifications and performance criteria for ACP and standard asphalt repair materials and placement will be as specified in this Design Set 1B Remedial



Figure 6-1 Sample ACP Cap Inspection Log

ACP CAP INSPECTION LOG

Use back of this sheet to sketch damaged locations on cap

Date of Inspection: _____

Name of Inspector: _____

Time of Inspection: _____

Weather Conditions: _____

Cap Inspection

Cap Damag Location and Description _____

Is Standing Water Visible? _____

Is Settlement Visible? _____

Is settlement greater or less than 3 inches? _____

- Dimension of settlement area _____

- Depth of settlement _____

Notes _____

Follow-up Inspections of Repaired Areas

Location _____

Notes _____

Design Report. Asphalt repair will be performed by identifying the extent of the failed area. The asphalt will be saw cut 2 feet beyond the failed area perimeter and the full depth of asphalt and base course material be removed. The subgrade will be inspected by proof rolling for deflection and replaced if necessary. The existing edges will be cleaned and tacking agent applied.

The ACP mix design must meet the permeability criteria for newly placed asphalt in repaired areas. Performance criteria and testing methods will follow the specifications and performance standards set forth in this design document and the Contract Documents.

6.3 Documentation and Reporting

The property owners will document cap conditions and relevant observations noted during each inspection. At a minimum, each inspection event will require that a log be completed (Figure 6-1). The Harbor Island S&G OU Steering Committee will provide an annual letter to EPA summarizing activities for the year.

7 References

- EPA, 1994. *EPA Sampling Summary, Harbor Island Soil, Positive Detections Greater than Reference*. Keith Rose, U.S. Environmental Protection Agency.
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- Portland Cement Association. Reprinted from: *Design and Control of Concrete Mixtures*. Portland Cement Association Publication EB001, 13th Edition.
- RETEC, 1997a. *Remedial Design Work Plan, Harbor Island S&G OU Superfund Site, Seattle, Washington*. Harbor Island S&G OU Steering Committee.
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